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ABSTRACT

The 45 energy education materials contained in this guide were evaluated by school teachers from California, Arizona and Nevada, and are listed here according to evaluation performance. The first five entries were found to be excellent teaching aids, and an entire activity has been included with each of these. The next 16 materials have a single sample page included with the evaluation information; the last six entries include no sample pages and have limited information from the evaluation. The materials are available for all elementary and secondary grades. Descriptive and evaluative information is given for each teaching resource along with ordering information. An appendix provides the following supplementary materials: an overview of the California environmental education curriculum and compendium project, a chart of the Unifying Concepts of Environmental Education, a Conceptual Matrix for Energy Education, a copy of the evaluation tool, and a listing of other energy curricula evaluated but not included in this compendium as well as several items not available for evaluation in early 1991. (MCO)

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ED355088

Environmental Education

Compendium for Energy Resources

A Cooperative Presentation by:
The California Department of Education
The California Energy Extension Service
Sonoma State University

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The California Department of Education,
The California Energy Extension Service in the
Governor's Office of Planning and Research
Sonoma State University
March 1992

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Preface

The Energy Challenge

California's energy system today faces a precarious future. Our use and choice of energy sources will dramatically affect our environment, our economy, and the legacy we pass on to future generations. By exploring all our available energy resource and efficiency opportunities, particularly for transportation, we will reap societal benefits. Informed decisions can slow the accumulation of atmospheric CO_2 which may cause or aggravate global warming, reduce congestion and air pollution, increase resource diversity, and improve security from fuel supply disruptions. The more efficiently we use our existing energy, the less we will have to depend on potentially unstable foreign sources.

California's transition to a diverse energy supply system is already in progress. During the 1980s, we responded swiftly to reduce oil dependency in the generation of electricity. In 1989, over half of our electricity came from non-fossil fuels. We have 50% of the world's geothermal plants, 82% of the installed wind capacity, and 99% of the utility-sized solar plants. A complete transition, particularly in transportation, our predominant area of energy consumption, will require millions of individual decisions about the purchase of automobiles, refrigerators, homes, and other energy- consuming products. Teachers are charged with helping students understand the energy choices of today while preparing them to become active participants in making those choices tomorrow. Today's students must be more than decision makers. They will be responsible for keeping California on the leading edge of new energy technology, a vital part of increased efficiency and diversity. The intelligence and ingenuity of today's students are perhaps our most valuable renewable energy resources

Energy as a Key Theme in Science

According to the *Science Framework for California Public Schools (1990)*, "Energy is a central concept of the physical sciences, it pervades biological and geological sciences because the flow of energy underlies any system of interactions." The flow of energy is what drives growth and development from both a biological and a societal perspective. Energy is perhaps the most important theme in physical sciences because all physical phenomena and interactions involve energy. Earth sciences, mountain building, volcanic activity, and earthquakes are all fueled by powerful nuclear reactions that occur deep beneath the planet's surface. The forces of wind, rain and the activities, of living organisms alter the face of the earth and are responsible for many geological processes. Energy is an important element in the considerations of ethical behavior and the relationship of science and technology to society. Thus, energy concepts are inherently interdisciplinary connecting the earth, life and physical sciences with the social sciences.

Easy-to-Use Materials Available at All Levels

The teacher who understands the importance of energy is faced with a daunting challenge—how to incorporate it into an already crowded curriculum and how to treat energy issues fairly and comprehensively. The purpose of this *Environmental Education Compendium for Energy Resources* is to enable teachers to teach more effectively about energy issues in the context of core curriculum by identifying a variety of materials available and providing samples of those materials.

As noted in the Appendix, this is one of a series of documents addressing natural resources. We hope these Compendia make it easier for you to respond to student interest in the environment. You will find that environmental education programs provide students with opportunities to strengthen leadership, communication, math, cooperative learning, and critical thinking skills.

Bill Andrews, Education Programs Consultant
Science and Environmental Education Unit
California Department of Education

Bonnie Cornwall, Senior Manager
Governor's Office of Planning and Research
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Contents

Acknowledgements ii
Preface iii
About this Compendium 1
Key to the Evaluations 3
I. ENERGY EDUCATION TEACHING MATERIALS 4
- Science Alive!, Unit I Energy Flow (gr. 4-6) 4
- 4th R Recycling Curriculum (gr. K-5) 6
- Conserve and Renew (gr. 4-6) 8
- Energy 90 (gr. 6-12) 10
- California State Environmental Education Guide (gr. K-6) 12
- Manipulative Energy Activities (gr. 4-6) 14
- Energy Food and You (gr. K-6) 15
- Connections (gr. 5-6) 16
- Iowa Developed Energy Activity Sampler (gr. 5-12) 17
- The California Class Project (gr. 7-9) 18
- Energenius Program (gr. 2-5) 19
- Let's Get Energized (gr. K-6) 20
- Hot Water and Warm Homes (gr. 4-8) 21
- Educational Development Services Kits (gr. K-12) 22
- Energy Activities for the Primary Classroom (gr. K-3) 24
- The NEED Project (gr. 3-12) 25
- California Challenge! (gr. 4-6) 26
- Energy Skill Builders (gr. 2-12) 27
- 4-H Home Conservation Guide (gr. 4-12) 28
- Top Hit Energy Lesson Plans (gr. K-6) 29
- Understanding Electricity (gr. 1-6) 30
- The Energist (gr. 6-12) 30
- Wind, Water, Fire and Earth (gr. 9-12) 31
- Manure, Meadow and Milkshakes (gr. K-6) 31
- Energy and Economics (gr. K-12) 32
- Know Nukes: Controversy in the Classroom (gr. 9-12) 32

II. APPENDIX 33
- Environmental Education Curriculum and Compendium Overview 33
- Unifying Concepts of Environmental Education 34
- Conceptual Matrices for Energy Education 35
- Evaluation Tool 36
- Additional Materials 38

About This Compendium

This *compendium* is an easy-to-use guide to energy education materials. While many teachers would like to include environmental education information in their lesson plans, finding appropriate support materials can be a time-consuming and complicated task. This *compendium* of curriculum materials has been developed to address these problems.

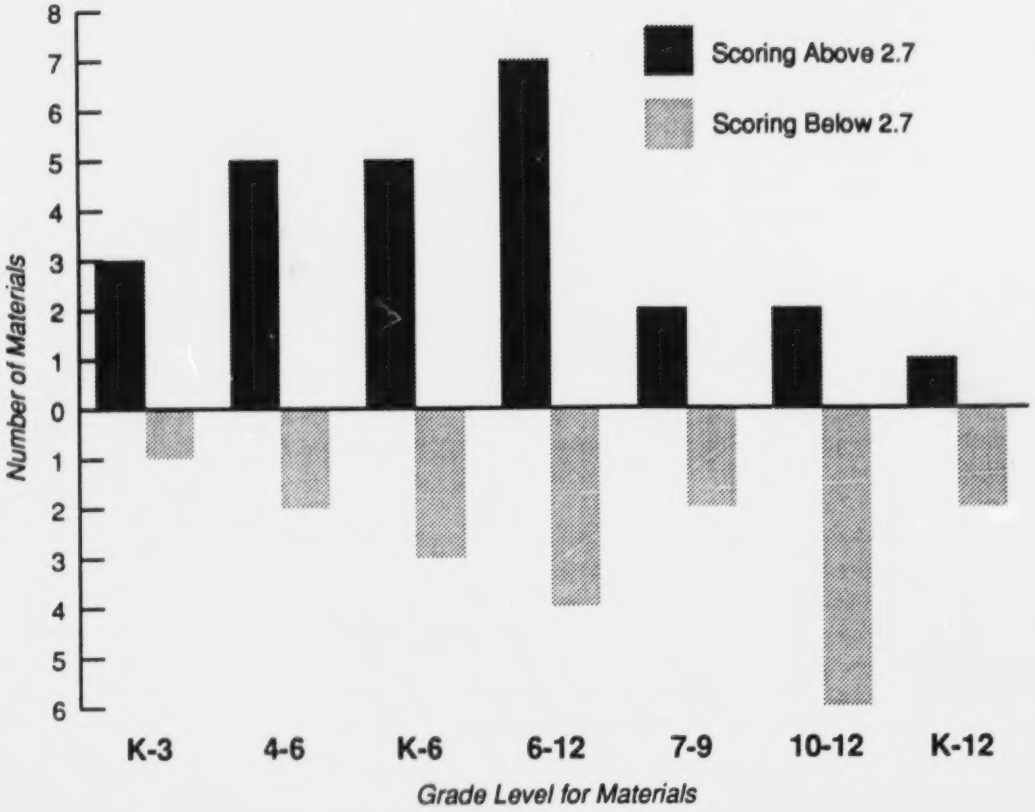
Teaching materials were evaluated by school teachers with the full range of teaching experience from kindergarten through twelfth grade from Northern and Southern California, Arizona and Nevada. This is not a comprehensive listing, only those 45 materials which we had immediate access to in the summer of 1991 were evaluated. Only the materials that performed well on the evaluation have full entries in this *compendium*. The information gained from the evaluation has been summarized on the following pages. The materials are listed here in the order of their performance on the evaluation. None of the materials received an average score above 3.4 out of 4 possible points. The first five materials listed in the *compendium* were found to be excellent teaching aids and we have included an entire activity with each of these. The next 16 pieces of material have a single sample page included with the evaluation information. The last six entries had average scores below 2.7, these include no sample pages and have limited information from the evaluation.

Materials are available for all grade level spans. Most writers targeted materials for a particular grade span. The largest number of materials reviewed were for the upper middle school span, grades 4-6, and these were also the highest rated materials. Senior high materials were generally thought to be of the lowest quality. Junior high, grades 7-9, had the fewest number of materials and they were only moderately successful. Few writers attempted to develop materials for K-12 and those too were of lower quality. Designers are good at organizing and producing easy to use materials, but the educators who reviewed the material felt more attention needed to be given to energy content.

On the following pages, you will find both descriptive and evaluative information about each piece of teaching material. A curriculum rating guide or "report card" addresses teaching and learning qualities, presentation and organization, and the energy education content. Comments from the evaluating teachers are also included. It is noteworthy that the average score for energy content alone was a C+, only 2.5. This clearly is an area that needs improvement. In addition, we have listed the basic ordering information for each of the curricula, so teachers will know their costs and how to obtain them. (See "Key to the Evaluations" on page 3.) In the Appendix, you will find an overview of the state's Environmental Education Curriculum and Compendium Project, the Unifying Concepts of Environmental Education, the Conceptual Matrix for Energy Education, a copy of the evaluation tool, and a listing of the other energy curricula evaluated, but not included in this compendium as well as several items not available for evaluation in early 1991.

We hope this *compendium* will be a valuable tool for teachers, so that energy education will become an integral part of the curriculum, teaching students how to protect and manage valuable resources.

Distribution and Average Score by Grade Level



Each piece of teaching material was given an overall score based on the evaluation tool included on pages 36-37. The highest number of points available was 4. This chart displays the number of materials, by grade level span, that scored above and below 2.7, essentially a B-. (Standard of deviation was >1 for this data.)

Key To The Evaluation

Title

Address and
Phone
of Publisher

Here you will find a short annotation. Number of pages, price, and year of publication are noted at the end of this paragraph (in parentheses).

On this side of the evaluation summary you will find a sample page from the material being evaluated.

Each piece of teaching material was given a "sun" rating based on an overall average score. The materials that received the best evaluations have a four sun rating. The next best materials got a three and one half sun rating, and so on.

REPORT CARD
grades K-12

Teaching and Learning .....A-

Presentation and
Organization .....A-

Energy Content .....B

Disciplines:
Interdisciplinary
Math
Science
Social Science
Geography
Language Arts

This "Report Card" tells you how the particular piece of teaching material was rated. There is a copy of the evaluation tool used on pages 36-37. This tool was used to determine the letter grades. Grade level and the discipline(s) addressed are also included.

Teaching and Learning: The pedagogy and general content is evaluated here.

Presentation and Organization: The ease of use is evaluated here.

Energy Content: Content accuracy and breadth is covered here.

Teachers' Thoughts: Illustrative comments made by evaluating teachers are highlighted in this section.

Science Alive!: Unit 1 Energy Flow

Science-Oriented Learning
Project Ocean
Oceanic Society, S.F. Bay Chapter
Fort Mason, Building E
San Francisco, CA 94123
(415) 441-5970

This is one part of an entire set of environmental education materials. These activities are set up to be used as units or individually. All activity worksheets are in both English and Spanish. While all the basics are covered, the more technical aspects of energy are not. (175 pages; $25/unit, $100 for a set of 5; 1987)

REPORT CARD
grades 4-6

Teaching and Learning .....A-

Presentation and Organization .....B+

Energy Content .....B+

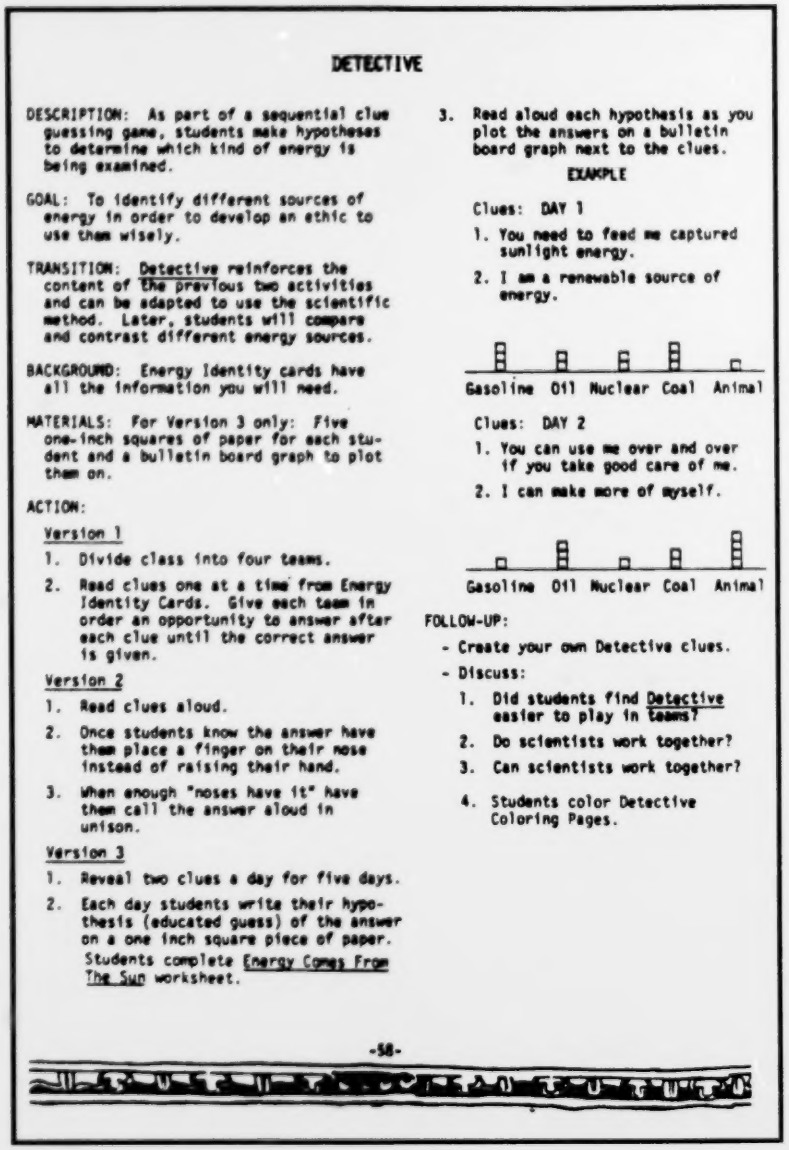
Disciplines:
Art
Language Arts
Math
Science
Social Studies

Teaching and Learning: Strong connections are made between energy and real-life situations. The activities do not skirt energy values and their societal implications.

Presentation and Organization: There are clear objectives. High quality student materials are provided. Organization is straight forward and simple to use.

Energy Content: There is a sound base of energy information.

Teachers' Thoughts: Accolades from all for this bilingual and culturally sensative curriculum material. The print was a little hard to read, but the fact that it makes hands-on activities available in both Spanish and English seemed to outweigh this deficit. You'll find "different activities than in many other curricula, e.g. linking energy to archeology. The connections to society were very clear. All and all it was hailed as "An excellent and practical program!"



DETECTIVE

DESCRIPTION: As part of a sequential clue guessing game, students make hypotheses to determine which kind of energy is being examined.

GOAL: To identify different sources of energy in order to develop an ethic to use them wisely.

TRANSITION: Detective reinforces the content of the previous two activities and can be adapted to use the scientific method. Later, students will compare and contrast different energy sources.

BACKGROUND: Energy Identity cards have all the information you will need.

MATERIALS: For Version 3 only: Five one-inch squares of paper for each student and a bulletin board graph to plot them on.

ACTION:

Version 1

1. Divide class into four teams.
2. Read clues one at a time from Energy Identity Cards. Give each team in order an opportunity to answer after each clue until the correct answer is given.

Version 2

1. Read clues aloud.
2. Once students know the answer have them place a finger on their nose instead of raising their hand.
3. When enough "noses have it" have them call the answer aloud in unison.

Version 3

1. Reveal two clues a day for five days.
2. Each day students write their hypothesis (educated guess) of the answer on a one inch square piece of paper. Students complete Energy Comes From The Sun worksheet.
3. Read aloud each hypothesis as you plot the answers on a bulletin board graph next to the clues.

EXAMPLE

Clues: DAY 1

1. You need to feed me captured sunlight energy.
2. I am a renewable source of energy.

Gasoline Oil Nuclear Coal Animal

Clues: DAY 2

1. You can use me over and over if you take good care of me.
2. I can make more of myself.

Gasoline Oil Nuclear Coal Animal

FOLLOW-UP:

- Create your own Detective clues.
- Discuss:
  1. Did students find Detective easier to play in teams?
  2. Do scientists work together?
  3. Can scientists work together?
  4. Students color Detective Coloring Pages.

-58-

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FOOD OR PLANT

1. I am a Renewable source of energy.
2. You can make more and more of me.
3. You have to plant me, water me and take care of me.
4. I am solid, but often I will bend in the wind.
5. I capture sunlight energy.
6. I need air, water, sun and soil to grow.
7. You harvest me to eat me.
8. I am the source of energy for the human body.
9. I do not polluta.
10. I am not expensive.
11. Different types of me grow in different countries.

ELECTRICITY

1. I am a renewable source of energy.
2. You can use a machine powered by water, gas, oil or the sun to make me.
3. I power your TV, radio, and lamps.
4. The machine most often used to make me is a turbine.
5. If you build a dam and let out water to roll it over the round turbine it spins so fast that it produces me.
6. You can only see me at night. During the day I am invisible.
7. I look like gold or silver sparks at night.
8. I can shock you.
9. Scientists discovered a way to produce me that uses renewable solar energy called photovoltaics.
10. Photo = light Voltaics = electricity.
11. Because you must use another source of energy to make me I am expensive.

OIL

1. I am a non-renewable source of energy.
2. There is only a little of me on earth.
3. I am black, thick and grey.
4. I am a liquid found deep underground.
5. It's hard to get me off of your skin, fur or feathers.
6. I am expensive to buy.
7. I am as old as the dinosaurs.
8. I am actually an ancient package of captured sunlight energy.
9. You use me in cars, buses, planes, ships and factories.
10. When you burn me I turn into black smoke that causes air pollution, can make it hard to breathe and can make you sick.

NUCLEAR

1. I am a non-renewable source of energy.
2. There is only a little of me on earth.
3. I am made from a rare solid rock (uranium) when it explodes.
4. Once I'm made I am poisonous and stick around for a long, long time (240,000 years!)
5. Scientists have yet to find a safe place to store the waste I create.
6. I am the most dangerous of all the energy sources.
7. I am very expensive to make in the first place.
8. If I wind up in the wrong hands, watch out, I could blow up the world.
9. You use me to make electricity.
10. More and more scientists believe I cause cancer.
11. You can build bombs out of me.

COAL

1. I am an ancient captured sunlight energy.
2. I am a non-renewable source of energy.
3. There is more of me than oil, but still my days are limited on Earth.
4. I am black, red or brown.
5. I am rock.
6. I am as old as the dinosaurs. In fact, I have dinosaurs buried inside me.
7. I am not very expensive to buy.
8. You burn me to heat your house, make old trains run or make factories work.
9. When you burn me I turn into thick, black smoke that pollutes the air. This makes it hard to breathe and can make you sick.
10. Scientists are inventing ways to use me wisely.

PLANTA O COMIDA

1. Soy una fuente de energía revovable.
2. Puedes hacer que nazcan otras como yo.
3. Me tienes que plantar, darme agua y cuidarme.
4. Mi especie es más antigua que la de los animales.
5. Soy sólida pero a veces me doblo con el viento.
6. Capturo la energía de la luz del sol.
7. Necesito aire, agua, sol y tierra para crecer.
8. Tú me cosechas, tú me comes.
9. Soy la fuente de energía para el cuerpo humano y otros animales.
10. No contamino.
11. No soy cara.
12. En diferentes países cultivan diferentes variedades de mi.

ELECTRICIDAD

1. Soy una fuente de energía no-renovable.
2. Tu puedes usar una máquina cuya potencia alimentadora sea agua, gas, aceite o el sol para construirme.
3. Soy la potencia alimentadora de tu televisión, tu radio y tus lámparas.
4. La máquina usada mas frecuentemente es una turbina.
5. Si construyes una presa y permites que el agua de vueltas rápidamente en la turbina, eso me produce.
6. Solo puedes verme de noche. Soy invisible durante el dia.
7. Me veo como chispas de oro y plata en la noche.
8. Te puedo dar toques o choques eléctricos.
9. Los cintíficos han descubierto un modo de producirme que utiliza energía renovable.
10. La invención científica para producirme usando la energía de la luz solar se llama fotovoltaico.
11. foto = luz voltaico = electricidad.
12. Porque necesitas usar otro recurso de energía para hacerme, yo salgo muy caro.

ACEITE/PETROLEO

1. Soy una fuente de energía no-renovable.
2. Solo existe un poco de mi material en la tierra.
3. Soy negro, grueso y gris.
4. Soy un líquido que me encuentro profundo en la tierra.
5. Es difícil despegarme de tu piel, pelanbre o plumas.
6. Cuesto mucho dinero.
7. Soy tan antigüo como los dinosaurios.
8. En realidad soy un paquete antigüo de energía solar capturada.
9. Me utilizas en los carros, camiones, aviones, barcos.
10. Cuando me quemas, me convierto en humo negro que causa contaminación del aire, hace que sea defícil que respires y te puede enfermar.

NUCLEAR

1. Soy una fuente de energía no-renovable.
2. Solo existe un poco de mi material en la tierra.
3. Soy producto de la explosión de una roca rara y sólida llamada uranio.
4. Ya que logran hacerme, soy muy venenoso y me quedo en la tierra por muchos, muchos años. (240,000 anos!)
5. Los científicos todavía tienen que encontrar un lugar seguro donde almacenar el desperdicio que creo.
6. Soy la más peligrosa de todas las fuentes de energía.
7. En primer lugar, cuesta mucho dinero hacerme.
8. Si caigo en malas manos, cuidense, puede hacer que explote todo el mundo.
9. Tú me utilizas para hacer electricidad.
10. Más y más cintíficos creen que causo cancer.
11. Tu puedes construir bombas con mi material.

CARBON

1. Soy rayos del sol capturados antigüamente.
2. Soy un recurso de energía que es no-renovable.
3. Hay más de mi que petroleo, aunque todavía me voy a acabar porque soy limitado.
4. Soy negro, rojo, o moreno.
5. Soy piedra.
6. Soy tan antigüo como los dinosauros. Es la verdad que llevo dinosauros antigüos adentro de mi.
7. No soy muy caro.
8. Me puedes quemar para calentar tu casa, y me usas para funcionar los ferrocarriles y las fabricas.
9. Cuando me quemas revuelvo en humo negro y con muchos partículos que contaminan el aire. Esto causa que respires con dificultad y te puede enfermar.
10. Los científicos estan inventando otras maneras de usarme mas eficiente.

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4th R: Recycling Curriculum

Check first with: PG&E, Ed. Services
77 Beale Street, Room 2825
San Francisco, CA 94106-9900 -or-
San Francisco Recycling Program
School Education Coordinator
Rm 271, City Hall
San Francisco, CA 94102
(415) 554-4851

This specialized collection of 50 recycling activities comes with some other "freebies" when ordered. "4th R" is a collection of ideas, lessons and activities designed to educate San Francisco students about waste-related issues and conservation. (150 pages; free in San Francisco, otherwise $10; 1985.)

REPORT CARD
grades K-5

Teaching and Learning .....B+

Presentation and Organization .....A-

Energy Content .....B+

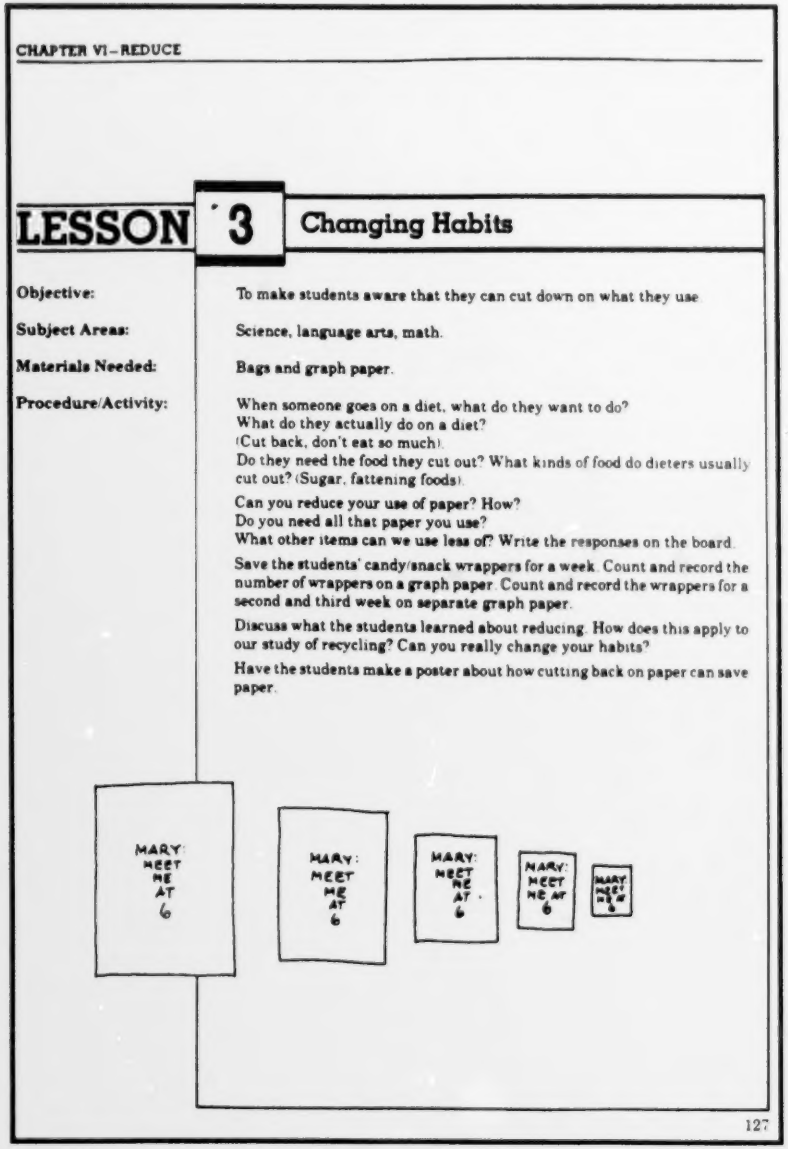
Disciplines:
- Language Arts
- Math
- Science
- Social Studies

Teaching and Learning: These teaching materials lack assessment devices and rate only fair on scientific method, but excel in relating information to students' life experience and hands-on learning. Societal connections are strong and the narrow focus of the materials allows them to treat recycling in depth.

Presentation and Organization: Very strong organization throughout, with especially nice student materials and adaptable to varied classroom situations.

Energy Content: Conservation is well served as a content area. Some dated information is the main limitation.

Teachers' Thoughts: Though these materials have a narrow focus on recycling in San Francisco teachers thought it was an excellent model for developing their own program. "4th R" got high marks from almost all teachers. It is very "teacher-friendly."



CHAPTER VI–REDUCE

LESSON 3 Changing Habits

Objective: To make students aware that they can cut down on what they use

Subject Areas: Science, language arts, math.

Materials Needed: Bags and graph paper.

Procedure/Activity:

When someone goes on a diet, what do they want to do?
What do they actually do on a diet?
(Cut back, don't eat so much).
Do they need the food they cut out? What kinds of food do dieters usually cut out? (Sugar, fattening foods).

Can you reduce your use of paper? How?
Do you need all that paper you use?
What other items can we use less of? Write the responses on the board.

Save the students' candy/snack wrappers for a week. Count and record the number of wrappers on a graph paper. Count and record the wrappers for a second and third week on separate graph paper.

Discuss what the students learned about reducing. How does this apply to our study of recycling? Can you really change your habits?

Have the students make a poster about how cutting back on paper can save paper.

127

LESSON 2 Will The Real Garbage Please Stand Up?

Objective:

To identify the contents of a trash can and determine the general categories of solid waste.

Subject Areas:

Science, math, social studies.

Materials Needed:

Chalkboard, samples of the following types of waste: glass, metal, paper, food, plastic (you may use an actual garbage can). You may use the solid waste from the previous lesson or bring materials from home.

Discussion:

What is garbage?

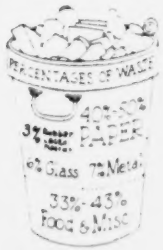
Talk about the connection between our shrinking supply of resources (trees, minerals, petroleum) and our growing pile of garbage.

How many times a day do you throw something away?

Where do you throw it? Where does it go?

What can you do with these materials besides throwing them away?

Procedure/Activity:



1. Place the trash on a large table, and go through it with the children. List the trash by categories on a chalkboard under one of the following headings: paper, metal, food, glass, plastic.
2. Which category do we have most of? Least of?
3. Draw a trash can on the board. With red chalk, draw a line for each piece of paper. Draw a green line for each piece of metal. Use different colors for glass, plastic and food.
4. What type of garbage do we have most of in the trash can? Why?

   (Show amounts of each type of garbage.) What could you have done to get more use from each item?

   Discuss the benefits of using resources and materials to the fullest before sending them "away" for "disposal."

   How can we help our environment in this way?

Follow Up:

You can sort the items of the class garbage can periodically to compare the contents. Take a field trip to a waste disposal site.

WORKSHEET A

Sample: "Sort the Garbage" Homework Parent Letter

School Name _____

Date _____

Dear Parents,

In Room _____, we have been studying recycling as part of our Science curriculum. As you may know, our society emphasizes products that are thrown away, rather than re-used or recycled. This has resulted in a tremendous problem in solid waste disposal. We are rapidly running out of space and money to dispose of our millions of tons of garbage. The solution to this problem ultimately lies in educating people to recognize the problem, and to develop the values of "reuse" and "recycle." The homework assignment for tonight will help the children to identify what actually gets thrown away at home, and to begin to think of alternatives. Since it is a messy assignment, here are some suggestions for safety and for preventing a bigger mess than necessary.

1. Use cloth or rubber gloves.
2. Take time to supervise your child as he/she completes the assignment. You'll learn a lot, too!
3. Be on the look-out for tops of cans and other sharp objects that can cause injury.
4. Spread the garbage out on plastic bags that have been split open for easier clean up.

If you feel that this is not an appropriate activity for your child, or that you simply don't want to be bothered with a messy activity, your child can complete the attached answer sheet by watching what gets thrown away for a day.

Thank you for your cooperation. We hope this will be an educational activity for the whole family!

Yours truly,

Teacher

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Conserve and Renew: Energy Education Activities for Grades 4-6

Energy Center
Sonoma State University
Rohnert Park, CA 94928
(707) 664-2577 -or-
PG&E, Ed. Services
77 Beal Street, Room 2825
San Francisco, CA 94106-9900

This collection of 23 activities is organized into sequential units, but each activity can be used individually. A glossary and a resources section are included. Each activity includes objectives, background section, materials list, step-by-step instructions, discussion questions, and extensions. (157 pages; $12; 1990.)

REPORT CARD
grades 4-6

Teaching and Learning .....B+

Presentation and Organization .....A-

Energy Content .....B+

Disciplines:
Art
Interdisciplinary
Language Arts
Math
Science
Social Science
Science, Tech. & Society

Teaching and Learning: The activities are all hands-on, include critical thinking, and are adapted for large and small groups. A strong connection is made between the energy information and real experience. There is a good balance between the amount of information covered and depth of treatment.

Presentation and Organization: Goals and objectives are clear and student materials amply provided. The text is engaging and the illustrations are fun. In a few instances, teachers may want more background information than is provided.

Energy Content: While energy dynamics, conservation and renewable energy activities are discussed in-depth, briefactivities for other energy sources are included.

Teachers' Thoughts: These materials hit a happy medium. The focus is narrow (conservation and renewable energy), but a lot of general energy content is offered. The format is teacher-friendly, and the bibliography is a wonderful resource. Teachers felt these materials were comprehensive and fit into their curricula.

INSULATION

OBJECTIVES: Students will determine how insulation can affect heat loss and heat gain.

SUMMARY: Students will monitor the different rates of temperature change in insulated containers.

GROUPING: 4-5 students.

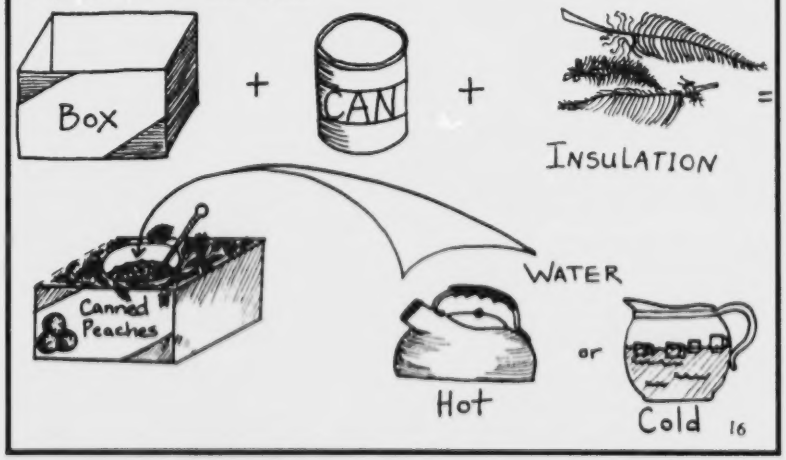
TIME: 40 min.

SUBJECTS: Science, math, language arts.

VOCABULARY: Insulation, relative change.

MATERIALS:
- ❑ Hot water and ice water
- ❑ A set for each group; three boxes & three cans (or other watertight containers that fit into the box with some space for insulation)
- ❑ Three types of insulation (e.g. sand, paper, quilting, air, sawdust, socks, construction insulation materials)
- ❑ Three thermometers per group
- ❑ Copies of the data chart for each student

PREPARATION & BACKGROUND: Collect the materials and make copies of the data sheet. Make sure you have access to HOT water and ice cold water (do not use the ice itself). More extreme starting temperatures provide more dramatic results. Have half of the groups experiment with ice cold water and half use hot water. Be sure the containers are insulated on the bottom as this will prevent some conductive heat loss.



PROCEDURE:

1. Break the class into groups.
2. Have each group collect their materials and assemble them. Make sure they are using three different insulating materials. Each group should predict which container will hold the temperature best.
3. When everyone is ready you can pour the water for them to be sure the insulation stays dry.
4. Have the students take a reading two minutes after the water is added, and again, once every five minutes for one half hour.
5. Have students do a lab write-up with graphs, results, and theories.

Feathers

NEWSPAPER

FOR DISCUSSION:

1. What materials held the temperature best?
2. Which material would be best for keeping your house warm? Cool?
3. What are some commonly used objects that use insulating materials? (down jacket, plastic thermos....)

EXTENSIONS:

1. Have students design containers that will hold in heat and give off heat. Once they are constructed, there could be temperature change races. Theories on heat transfer can be developed.
2. Get extra thermometers and measure the temperature at the top and bottom of the containers to illustrate thermal stratification and the relative rates of loss.
3. Set up a control container and monitor temperature changes with no insulation.

FIND THE BEST INSULATOR

Names:

____ Ice water ____ Hot water

INSULATION MATERIAL USED	ELAPSED TIME IN MINUTES						TEMPERATURE CHANGE
	5	10	15	20	25	30	

1. What was the best insulating material?

2. What was the worst insulating material?

3. How can you use insulation to save energy at school and at home?

93

Energy 90

Enterprise for Education, Inc.
1320-A Third St., #202
Santa Monica, CA 90401
(310) 394-9864

These extensive materials have activity guides for teachers, an attractive student booklet, and are designed to either enhance traditional courses with energy information or to create an interdisciplinary course in energy. An 8-part (5-book) set of books go with the Teacher's Guide, and any part can be used separately. Designed for 8th graders, these may be useful in grades 5-12. (624 pages: $42.50 for the 8-volume Teacher's Guide and $1.75 each for the student booklet; 1989.)

REPORT CARD
grade 8

Teaching and Learning .....B+

Presentation and Organization .....B+

Energy Content .....B+

Disciplines:
Science
Social Studies

Teaching and Learning: These materials use the scientific process in hands-on activities. There is usually a connection to student's experience. Concepts are covered in-depth.
Presentation and Organization: The goals and objectives are clearly stated in the beginning, but the organization becomes cumbersome from there on.
Energy Content: At times the connection of energy to values and society is vague, but otherwise energy is covered very thoroughly.
Teachers' Thoughts: This is a HUGE collection of material, enough to be intimidating to some of the teachers reviewing it. The student materials are bright and interesting. Most of the teachers said, with some effort and time, this is a wonderful resource. "There is everything you'd ever need to teach about energy in here somewhere. All you have to do is find it!"
Note: Energy Skill Builders on page 27 are abbreviated versions of some of these materials.

ECONOMICS AND
DECISION-MAKING

Buying Energy Abroad

Days Required: 1

For this sequence, your students will need:
pp. 40 & 41 of the student booklet.

Student Learning Outcomes

- Students identify petroleum as the leading commodity in international trade.
- Students recognize that the United States now buys from abroad about half the petroleum it uses.
- Students demonstrate an understanding of the meaning of "balance of trade" by questioning whether it is possible to go on indefinitely buying more than one sells.
- Students suggest some difficulties that may result from our large dependence on foreign petroleum supplies.

Suggested Teaching Strategy

Petroleum and gas are traded throughout the world. Look at the chart on pages 40 and 41 of the student booklet. How many different colors of arrows are there? What do the colors represent? What is the significance of the differences in widths of the lines?

Petroleum is moved about the globe mostly from areas of little technology to areas of high technology. The largest amounts of petroleum come from a few areas of the world. Ask your students to find these areas and try to identify the countries from which most petroleum is exported. Write the names of these countries on the map.

117

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The arrows on the map indicate petroleum and gas shipments, not petroleum and gas consumption. Be sure students understand that many countries also consume domestically produced oil and gas, and that such consumption does not show up in the arrows. Point out that the arrows to Japan and the United States are about the same size. Does this mean that Japan and the United States use about the same amount of petroleum?

At present, natural gas is not as important an import/export commodity as crude oil. Ask your students to review the chart on pages 34 and 35 of **Energy 85.** This chart shows that in the United States natural gas provides about half as much energy as oil does. Compare that difference with the difference in trade shown by the arrows on pages 40 and 41. Why do you think the United States doesn't import nearly as much natural gas as it does crude oil? Overall, how does the trade in natural gas or coal compare with that of crude oil? Why?

To obtain crude oil from other countries, we must trade something for it. Oil is being exported largely from less-developed countries to more industrialized ones. Make a list of products for which people in the less-developed countries might be willing to exchange their oil. Try to indicate where these materials might come from (food and industrial tools might come from the United States, tools and the skills to use them from Europe, Japan or the USSR). Might they also be willing to take ownership of farms and businesses in the United States?

Now ask your students to estimate how much oil is used to run their community. Estimate the quantity of oil by multiplying the number of people in the community by 12 (the national per capita average of imported barrels of oil used). Translate this quantity to dollars by multiplying by $34 (per barrel). Now find an industrial product or agricultural product produced in your community. What does the product sell for? How much of this product would have to be sent abroad to pay for the amount of foreign oil used by the community?

At this time, oil exporters are willing to trade oil for dollars. This is suggested by a picture on page 41. Why would oil exporters be willing to take dollars for their oil?

116

Mini-Quiz

1. What is the biggest single item in international trade?
2. What country buys the most oil?
3. From what country do we import the most oil?
4. Name an African nation from which we import oil.
5. About how much did we spend in 1980 on imported oil?
6. About how much of the oil that we consume is imported?
7. Why are oil exporters willing to trade oil for dollars?
8. Name one danger to the United States from depending on imported oil.
9. Name two actions that would make us less dependent on imported oil.
10. How does the amount of coal and natural gas traded compare with the amount of oil traded?

True or False?

1. The United States buys large amounts of oil from Africa.
2. Our oil imports cost $50 billion in 1981.
3. If it were not for OPEC, the cost of oil would not rise.
4. We import and export natural gas from and to Mexico.
5. We get most of our imported oil from Canada and Mexico.
6. People in the United States need not be concerned about where the oil they use comes from.
7. The United States exports coal to Japan and Europe.
8. Australia is a coal exporter.
9. The United States imports petroleum from Indonesia.
10. The United States buys large anounts of oil from China.

119

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California State Environmental Education Guide

Alameda County Office of Education
Media Sales
313 West Winton Avenue
Hayward, CA 94544-1198
(510) 670-4168

This is a guide for teaching environmental education which contains a seven- activity unit on energy. Only the energy unit was evaluated.
(323 pages, $17.95 + tax; 1988.)

REPORT CARD
grades K-6

Teaching and Learning .....B+

Presentation and Organization .....B+

Energy Content .....B-

Disciplines:
Language Arts
Math
Science
Social Studies

Teaching and Learning: This guide does a particularly good job of getting students out of the classroom and handling information in depth.
Presentation and Organization: It is very easy to find the objectives and goals for each activity and the entire book is thoughtfully organized. More illustrations would have been welcome.
Energy Content: There is some energy conservation included here but the coverage of renewable energy was not thorough. It should be noted that this is not an energy education publication, rather it includes one unit on energy.
Teachers' Thoughts: Everyone noted the superior organization and ease of use. The energy content is understandably limited but content covered is in good depth. Everyone appreciated the fact that each activity is referenced to the state frameworks.

Introduction to the Unit

Energy is the capacity to do work or the ability to make things move. Energy comes in several forms —sound, light, heat, active (kinetic energy), and stored (potential energy)—and can be converted from one form to another. When we speak of energy as a resource we are usually talking about potential energy that can be converted to other, more useful types of energy like heat, light, motion, or sound. Examples of potential energy resources are food, water held behind a dam, coal, oil, and gasoline.

Energy is a vital part of our everyday lives. Food provides us with the energy to live and grow, we depend on electrical energy for our refrigerators and lights, energy provides us with hot water in our homes, and our cars and buses require energy from gasoline. We depend on energy in various forms for everything we do.

As a nation we have become economically dependent on large amounts of energy. This dependence has caused problems like air pollution and acid rain (caused by burning fossil fuels like petroleum, oil, natural gas), the possibility of damaging oil spills (caused by drilling rigs or tankers), political and military tensions (caused by dependence on foreign oil), the dwindling supply of oil and other fossil fuels, and safety questions about nuclear power plants and the wastes produced there.

Because energy is a broad, complex, and controversial topic that affects the quality of our lives and the environment, it is important that it be addressed in the classroom. In the first two activities students conduct hands-on experiments with solar energy. In the following activity students learn through observation and discussion ways to tell when energy is being used. The following two activities help students gain an understanding of more commonly used energy sources. In the final two activities students look at energy use at home and try some energy conservation measures.

Throughout this unit the teacher might encourage students to bring in energy articles they find in newspapers and magazines. Have students read or summarize their articles for the class and keep a bulletin board available for posting current energy news. Help students see the relationship between the activities of this unit and the news articles they collect. Make explicit the tie between what students are learning in the classroom and what is happening in the rest of the world.

Advance Planning

For the first two activities, "Let the Sun Shine In" and "Testing a Hypothesis," you will need one thermometer for each pair of students and one styrofoam cup or other standard container for each student. For "Researching Energy Sources" you will need to make sure that students have access to reference materials about energy. Several titles are suggested in the activity. Additionally, you may wish to check out books from the public library or ask if local utility companies and ecology centers distribute free literature on energy.

Resources

See the California State Resource Agencies section for energy materials available from energy agencies.

UNIT TIMELINE ■ Participation in Activity ▭ Ongoing observation and study

Page	Activity	Week 1	2	3	4
225	Let the Sun Shine In				
230	Testing a Hypothesis				
234	Are You Using Energy?				
236	Researching Energy Sources				
239	Energy Murals				
241	Home Appliances Survey				
246	Energy Contracts				

224 THE CALIFORNIA STATE ENVIRONMENTAL EDUCATION GUIDE

ENERGY CONTRACTS

SUMMARY OF ACTIVITY

Students decide what actions they would be willing to take for one week to save energy, write a contract stating their intentions, then discuss the results after a week.

Time: Two 30- to 45-minute periods, one week apart

Setting: Classroom, home

Materials:
- One piece of butcher paper
- Writing paper

Subjects: Science, language arts

Key Words: Energy usage, conservation, alternative, choice, action

RELATED CALIFORNIA FRAMEWORK CONCEPTS

Conservation of resources is an ethical concern of individuals and societies. (*Science Framework Addendum*)

Care and conservation in the use of energy and in the choice of energy sources involve personal behaviors as well as public policy. (*Science Framework Addendum*)

OBJECTIVE

Students choose alternative actions to conserve energy, carry out the actions for a week, and evaluate the results.

BACKGROUND INFORMATION

Americans use more energy per person than people in almost any other country, including countries with similar lifestyles. There are many ways we can conserve energy. Conservation can be as simple as acquiring the habit of turning off lights when we aren't using them or as complex as developing cars that use renewable energy sources. Conservation can also mean changing behaviors; for instance, taking shorter showers or walking instead of driving for short trips.

A 1986 study sponsored by a major California utility found that if Californians used most efficient lights and appliances, energy consumption would be cut by 25 percent. The initial cost for these energy-saving appliances would be greater than appliances used today, but the appliances would pay for themselves over time.

This activity gives students the opportunity to decide how they can conserve energy. Obviously, the actions students undertake will not affect global or national energy consumption; however, the world is shaped as much by the seemingly minor actions of many people as it is by the significant actions of a few people. It is important for students to know they can make choices that make a difference.

PREPARATION AND LEAD-UP

On butcher paper write an energy contract like the contract illustrated for step three.

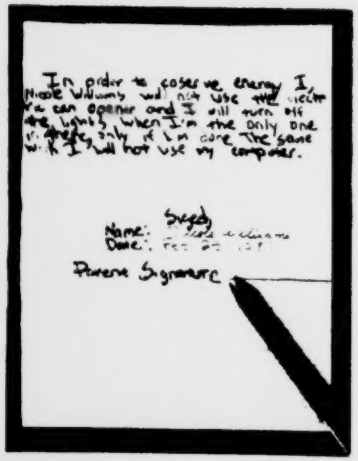
PROCEDURE

1. Ask students to explain why we should care about conserving energy. If students have been discussing energy issues covered in the news, review articles that describe energy shortages, non-renewable energy sources, energy costs, energy independence, and health problems associated with pollution and other effects of energy use.

2. Ask students to suggest ways they can save energy. Introduce students to the notion of saving energy by making choices that save energy. Such choices might include taking shorter showers, washing hair in a sink instead of the shower, not leaving water running while washing dishes, defrosting the freezer, closing the refrigerator door as quickly as possible, and turning off lights, televisions, radios, and stereos when no one is in the room.

3. Ask students to decide on one or more ways they will conserve energy for the next week. Post the sample energy contract and help students write out a contract stating their week-long commitment to conserve energy. Collect and save the contracts until the week is over.

ENERGY CONTRACTS *(Continued)*


In order to conserve energy I,
Nicole Williams will not use the electric
fan as often as I can and I will turn off
the lights when I'm the only one
in the room. I will not use my computer.
Name:
Date:
Parent Signature

4. Tell students that each night they are to write two or three sentences about how they are saving energy. During the week ask students periodically how they are doing and find out if they are running into any difficulties keeping their contracts.

5. At the end of the week, return the contracts to students. Ask students to re-read their original contract and then write a summary explaining whether they were able to keep to their plan, what difficulties they found, any unusual thing that happened, anything they learned about their habits and use of energy, and how they felt about making choices to conserve energy. Discuss the results (see the discussion questions).

DISCUSSION QUESTIONS

Were you able to follow through with your plan to conserve energy? Why or why not?
Was it easy or hard? Why?
What would make it easier for you to conserve energy?
What do you think might make it easier for other people to conserve energy?

EVALUATION

The students' written work in step five can serve as an evaluation of their understanding.

EXTENSION IDEAS

- Have students work alone or in small groups to design an energy conservation public service announcement. Students can present their announcements to the class. If your school uses a public address system, perhaps several students could present their announcements to the whole school.
- Have students write letters to the editor of the local newspaper about any energy topic they wish. Mail the letters and ask students who get the paper at home to look for letters written by their classmates.

36 BEST COPY AVAILABLE 37

Manipulative Energy Activities

Louisiana Department of Natural Resources
Energy Division
P.O. Box 44156
Baton Rouge, LA 70804-4156
(505) 342-1399

This collection of 20 activities is preceded by 2-1/2 pages of introduction, energy conservation principles and an instructional philosophy. (48 pages; free; 1987.)

REPORT CARD
grades 4-6

Teaching and Learning .....B

Presentation and Organization .....B+

Energy Content .....B-

Disciplines:
Math
Science

Teaching and Learning: This teaching material is organized thematically. The activities do a fair job of encouraging hands-on experience. Assessment devices were lacking and learning is restricted to the classroom.
Presentation and Organization: These activities appeared easy to use and had fun illustrations. Teachers felt a need for more suggestions to extend the lessons.
Energy Content: "Manipulative Energy Activities" covers various energy sources, but does not treat energy flow or social effects of energy use in-depth.
Teachers' Thoughts: Teachers really liked the simple to use format and all the hands-on activities found here. Most of the comments were very favorable, everyone wanted a copy for themselves.

Activity Q: Chocolate Chip Mining

Energy Principles Taught:
2, 4

Concepts

- Some forms of power generation pose some form of risk to the environment.
- There should be a balance between a need for energy and a need for a clean environment.
- Care must be taken to preserve and/or restore the environment.
- Some forms of energy are easily obtained.

Objective

The students will be able to:

- infer problems associated with the mining of coal and uranium, such as the loss of land for other uses, loss of aesthetics, and accidents.

Application to Energy Conservation

Shale has been explored in recent years as a source of oil. The cost of production is much greater than oil well production because of the extraction process. Likewise, oil obtained from deep wells and from offshore drills in the ocean is more expensive than that from shallow wells, such as those in Saudi Arabia or north Louisiana, because of the energy consumed by expensive extraction processes. Students can compare these facts to the recovery of chocolate chips from the two types of cookies. Which chips were easier to remove, thus resulting in a less costly process? Why do we need to consider the cost of energy needed to remove or recover sources of additional energy?

Suggestions

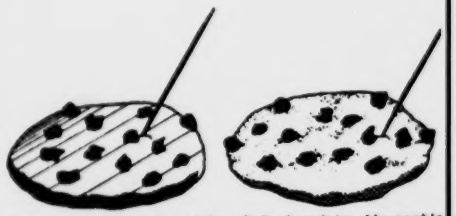
Discussion should include suggestions on how to repair the cookie, leading into discussion of ways to improve the environment after mining.

Materials

Soft and hard chocolate chip cookies
Toothpicks
Paper towels

Procedures

Students investigate the removal of chocolate chips from two types of cookies, simulating the removal of energy materials from different areas in the earth's crust. The object is to remove the chips with the least amount of damage to the cookie, thus the least amount of harm to the environment.



Hard chocolate chip cookie Soft chocolate chip cookie

24

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Energy, Food, and You

Washington State Office of Environmental Education
17011 Meridian North
Seattle, WA 98133
(206) 542-7671

This is an interdisciplinary curriculum guide with food and nutrition-oriented energy education activities. One is for grades K-6, which is presently being re-written. Another is for grades 7-12 and is available now.
(292 pages; $12 each; 1983.)

REPORT CARD

grades K-6 & 7-12

Teaching and Learning .....B

Presentation and Organization .....B

Energy Content .....B

Disciplines:
Drama
Language Arts
Math
Music
Science
Social Studies
Spelling

Teaching and Learning: While the assessment devices are weak, the materials have good hands-on activities. Various learning styles are included. Both rural and urban students will find this material relevant. Personal decision-making is well-addressed.

Presentation and Organization: The illustrations are fair, and the objectives and goals of the teaching materials are clearly stated. The writing is engaging and student materials are provided.

Energy Content: The lessons cover the basics of energy very well and get students actively involved in energy conservation. Some energy sources and the relationship between renewable and nonrenewable energy are not extensively covered.

Teachers' Thoughts: There are a lot of activities here, and they're presented in a fashion that is not overwhelming. Teachers loved the Table of Contents that included the goals and disciplines addressed by the activity. Everyone liked this material, but wanted to see the illustrations redone. The food theme for teaching energy seems a great motivator for kids.

ACTIVITY TITLE: "Drawing" Attention to Energy Sources (Game)

CONCEPT: Although the sun is the primary source, there are many sources of energy. Some energy sources are renewable and some are nonrenewable.

SUBJECT AREA: Science, Art

GRADE LEVEL: Primary

OBJECTIVE: To understand that most of our energy comes from the sun.

MATERIALS:
Crayons
Four large sheets of butcher paper

ACTIVITY:

1. Divide the class into groups of four or five.
2. Each member of the small group is given a number.
3. Provide each group with crayons and one large sheet of butcher paper.
4. At a starting signal, number one from each group runs up to the teacher who whispers the same energy source to them.
5. They run back to their groups and draw that source, not talking, until someone whispers the correct identification.
6. Number two runs to the teacher, whispers the answer and if correct, receives the second item on the list to draw.
7. Progress through 10 items.
8. Remind students they must whisper the answer or another team will overhear.
9. Discuss team cooperation and consideration.

Suggested terms:

1. Food
2. Wind
3. Water Power
4. Sun
5. Ocean Currents
6. Oil
7. Gasoline
8. Garbage
9. Wood
10. Compost

BIBLIOGRAPHY AND RESOURCES:

Energy and Conservation Education, Activities for the Classroom, Grades 1-3. Energy & Man's Environment Inc. (EME). Portland, Oregon 97201.

Oregon Dept. of Energy, The Family Energy Watch Calendar, Dept. of Energy, 528 Cottage St. N.E., Salem, Oregon 97310. $1.50.

Connections

National Center for Appropriate Technology
c/o Publications
Box 3838
Butte, Montana 59701
(406) 494-4572

"Connections" is an assortment of energy activities teaching about appropriate technology. The activities illustrate the concepts of recycling, conservation, and renewable energy. Quizzes are provided for each lesson, and there is an entire section of handouts. (108 pages; $7; 1980.)

REPORT CARD
grades 5-6

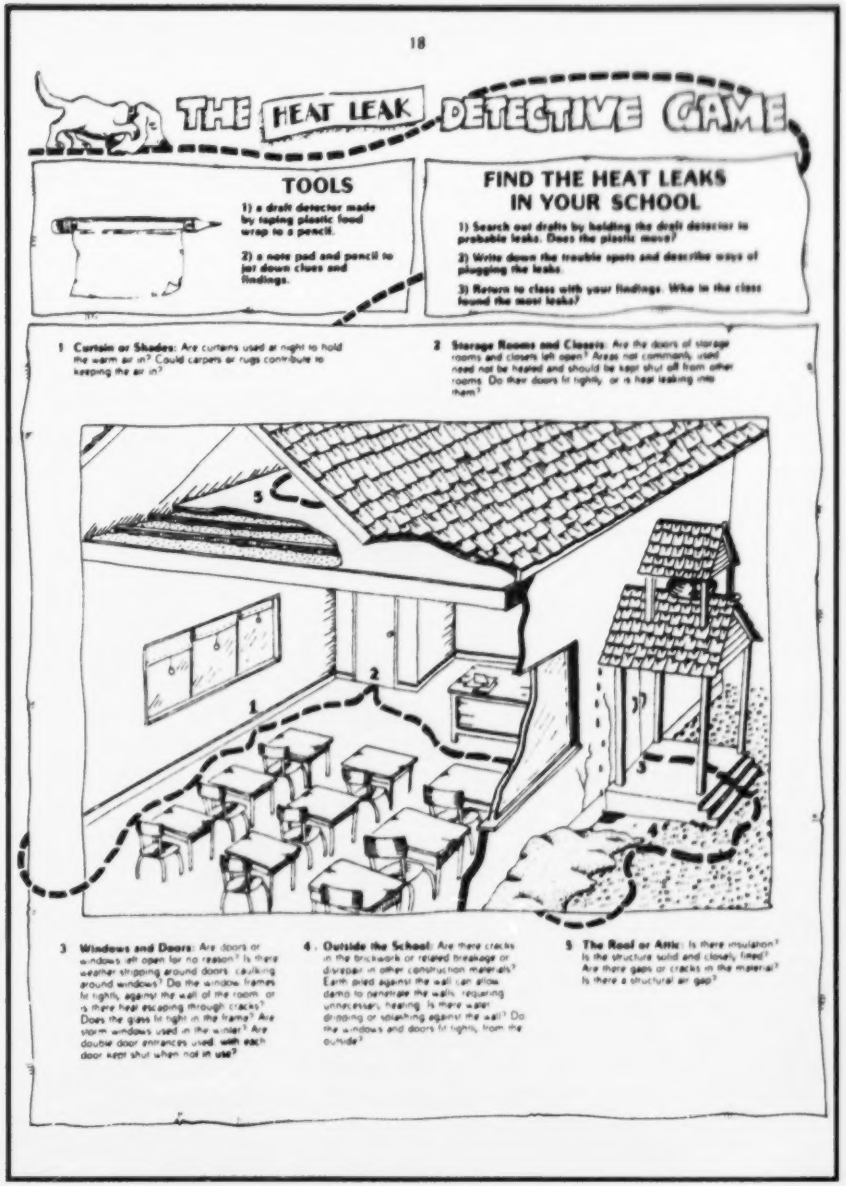
Teaching and Learning .....B

Presentation and Organization .....B

Energy Content .....B

Disciplines:
Art
Interdisciplinary
Math
Social Studies

Teaching and Learning: These materials do a good job of expanding the classroom and connecting information with real experiences. "Connections" includes some good student participation activities that teach about energy, society and technology. Assessment devices are fair.
Presentation and Organization: Fair illustrations and clear objectives make the materials easy to use. The activities were readily integrated into an established curriculum.
Energy Content: All the energy basics are covered, but not always in great depth.
Teachers' Thoughts: There are home activities included and the historical perspective was unique. Several teachers noted the small type as being a little difficult to read. Most felt that, with a bit of outside research, the materials were adaptable to varied classrooms and more grade levels than indicated. This material got very mixed comments.


18
THE HEAT LEAK DETECTIVE GAME
TOOLS
1) a draft detector made by taping plastic food wrap to a pencil.
2) a note pad and pencil to jot down clues and findings.
FIND THE HEAT LEAKS IN YOUR SCHOOL
1) Search out drafts by holding the draft detector in probable leaks. Does the plastic move?
2) Write down the trouble spots and describe ways of plugging the leaks.
3) Return to class with your findings. Who in the class found the most leaks?
1 Curtain or Shades: Are curtains used at night to hold the warm air in? Could carpets or rugs contribute to keeping the air in?
2 Storage Rooms and Closets: Are the doors of storage rooms and closets left open? Areas not commonly used need not be heated and should be kept shut off from other rooms. Do their doors fit tightly, or is heat leaking into them?
3 Windows and Doors: Are doors or windows left open for no reason? Is there weather stripping around doors, caulking around windows? Do the window frames fit tightly against the wall of the room, or is there heat escaping through cracks? Does the glass fit tight in the frame? Are storm windows used in the winter? Are double door entrances used, with each door kept shut when not in use?
4 Outside the School: Are there cracks in the brickwork or recent breakage or disrepair in other construction materials? Earth piled against the wall can allow damp to penetrate the walls, requiring unnecessary heating. Is there water dripping or splashing against the wall? Do the windows and doors fit tightly, from the outside?
5 The Roof or Attic: Is there insulation? Is the structure solid and closely fitted? Are there gaps or cracks in the material? Is there a structural air gap?

BEST COPY AVAILABLE

Iowa Developed Energy Activity Sampler

Department of Education
Grimes State Office Building
Des Moines, Iowa 50319-0146
(515) 281-5294

This is a large collection of hands-on activities designed for use in Iowa. Background information, student handouts and worksheets are included for each set of activities. (750 pages; $20, free to Iowa teachers with workshop; 1989.)

REPORT CARD

grades K-12

Teaching and Learning .....B

Presentation and Organization .....B

Energy Content .....B-

Disciplines:
- Art
- Interdisciplinary
- Language Arts
- Math
- Science
- Social Science
- Science, Tech. & Society

Teaching and Learning: Assessment devices are lacking, but the hands-on activities treat energy information accurately and make strong connections to real-life experiences. The general content of the material is of good quality.
Presentation and Organization: The goals and objectives are clear, but the organization is not. Student materials are provided and they are easy to understand and use. The presentation is a bit dry.
Energy Content: There is information on various energy sources, and the relationship of energy to society and technology is explored. Basic energy content is also covered.
Teachers' Thoughts: There were very different reactions to the organization of these materials --- some liked it, while others felt it was cumbersome. Everyone agreed it was rather plain and unexciting in appearance. This is one of a few of the materials evaluated that include rural-specific energy activities and integrated disciplines.

Primary - Unit II - Activity 4

TITLE The Sun Is My Friend

SUBJECT Science, Art, Math Shapes **LEVEL** K

ACTIVITY IN BRIEF

The students will work with the sun's heat energy and light energy by being able to feel and read the sun's warmth and by being able to see the results of the sun's light energy.

OBJECTIVE

Each student will be able to identify the sun as a source of heat energy and light energy.

MATERIALS

Two thermometers, 2 pans of water, colored piece of construction paper per student, assortment of rocks, leaves, shells or use 4A (math shapes)

TIME

Optional, depending on group size, and sunny and cool locations

LEARNING CYCLE

AWARENESS - To demonstrate the sun's heat energy, first take the students to a warm, sunny place in the classroom or school building. Then take them to a cooler place (example: storage room) without the lights on. As a group activity, discuss the differences in warmth. Let the children "guess" at the temperatures in both areas and list these on chalkboard. Be sure they understand the concept of temperature and how it is measured. (This may have to be modified for seasonal temperature changes.)

CONCEPT DEVELOPMENT - Now place thermometers in these two different areas. At a later time, retrieve the thermometers, and put the temperatures on the board. Allow students the chance to "read" the thermometers with help.

APPLICATION - To demonstrate the sun's light energy, students arrange leaves, shells, rocks, etc. on colored paper, and leave in sunlight. Or to reinforce basic math shapes, have students arrange their cut-outs of rectangles, squares, circles, triangles in same way.(see 4A) Discuss results.

EVALUATION - After the Application Session, ask each student what makes buildings, classrooms, cars, homes, etc. warm besides furnaces and heaters. Ask why or how the shapes appeared on their colored paper.

BEST COPY AVAILABLE

The California Class Project

California Department of Education
Bureau of Publications, Sales Unit
P.O. Box 271
Sacramento, CA 95812-0271

This is a collection of environmental education activities with a 6 activity unit on energy. These materials were initially developed and piloted by the National Wildlife Federation. Only the energy section was evaluated. (367 pages; $28 + tax; 1988.)

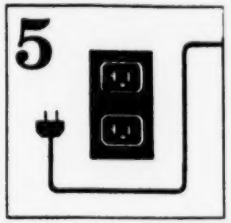
REPORT CARD
grades 7-12

Teaching and Learning .....B	Disciplines:
Presentation and Organization .....B+	Art Interdisciplinary Language Arts Math Science
Energy Content .....B-	Social Science Science, Tech. & Society

Teaching and Learning: These materials are applicable in both urban and rural settings. The content is treated accurately but not always in depth. There is a need for assessment devices.
Presentation and Organization: The materials are very clear and easy to use but the illustrations are lacking a bit.
Energy Content: While not all energy concepts are covered, there is strong participation in energy conservation included.
Teachers' Thoughts: Teachers liked how math (graphs and charts) was integrated with home life. Some felt that they would have to do a lot of background work to support the activities and several teachers lamented a lack of experiments. Each activity requires several class periods to complete.

GOING... GOING... GOING...

5



UNIT I - Lesson 5 Teacher Instructions

OVERVIEW

Students investigate the efficiency of transportation systems by comparing several community maps and designing a plan for one ideal community.

FOCUS

Students will:
- identify methods of transportation and situations where they are most appropriately used;
- analyze maps of several communities for transportation efficiency; and
- design their own transportation system to meet the needs of a given community.

AT A GLANCE

ADVANCE PREPARATION: Duplicate appropriate materials.
DURATION: 4-5 class periods
GROUPINGS: whole class and small groups
MATERIALS: large sheets of white paper, marking pens, colored pencils or crayons, and the following:

TRANSPARENCIES:
A - Lasource City Map
B - Vinton City Map
C - Rickman City Map
D - Greenville Map
E - Transportation Efficiency Rating Chart

STUDENT WORKSHEETS:
#1 - Community Analysis
#2 - Lasource City Map
#3 - Vinton City Map
#4 - Rickman City Map
#5 - Greenville Map

STUDENT HANDOUT:
- Stewart Udall's Excerpt

CROSS CURRICULUM CONNECTION: language arts, mathematics, social science
PROCESS SKILLS: observing, communicating, comparing, organizing, relating, inferring, applying

VOCABULARY

carbon monoxide, chemical energy, hydrocarbon, mechanical energy, nitrogen oxides, petroleum

Energenius Program

Local Pacific Gas and Electric Offices

This set consists of posters, a calendar, a teacher's guide, a video (not evaluated), stickers, a badge, and student worksheets. These all support a lesson on how to save energy at school and at home. (38pages; free from local P.G.& E office, 1990.)

REPORT CARD

grades 2-5

Teaching and Learning .....B

Presentation and Organization .....B+

Energy Content .....C+

Disciplines:
Interdisciplinary

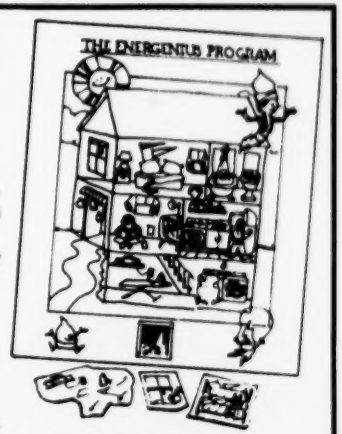
Teaching and Learning: The information is related in real life terms but does not go into great depth. There is not a strong use of the scientific thought process.
Presentation and Organization: The instructions for using this material were very clear and concise. Some teachers felt it could use some extensions.
Energy Content: This is designed to teach about gas and electricity only. The conservation elements were well related to the students' experience.
Teachers' Thoughts: There is lots of color in this packet but the hands- on activity is limited. There is a narrow focus on home conservation and for this reason teachers thought it should be supplemented with other information.

2nd & 3rd grade

Energenius Habits Exercise

This activity focuses on saving energy by replacing wasteful habits with conserving ones. After a teacher-led discussion about appliances and how they are powered, the class explores energy wasting practices. Using a large cutaway poster of a house depicting children using energy wastefully, students affix stickers that place energy saving habits over wasteful acts. Individual sticker sets are provided for each student to reinforce these concepts.

Package includes: Large Energenius Posters (27"×34") with corrective stickers, Small Poster (16"×20"), individual Sticker Sets, Coloring Sheets, and Energenius Badges.

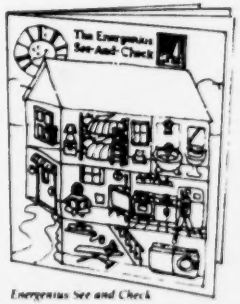


Energenius Habits Poster with Stickers

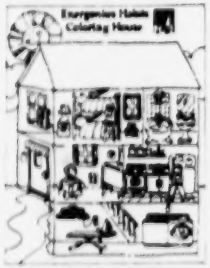
Energenius See and Check

This lesson prepares students to conduct a 10 question survey of energy practices in their own homes. By carefully observing how energy is used or misused, students will be able to identify specific areas where energy and money can be saved with very little effort.

Package includes: Teacher Guide, individual See and Checks, Energy Survey Forms, and Energenius Certificates.



Energenius See and Check



Energenius Coloring Sheet

Energenius Calendar

A calendar in coloring book format focuses attention on timely energy saving habits each month, along with entertaining seasonal facts. By tying energy use to seasonal variations, students learn how changes in weather affect their energy use.

Package includes: Individual Calendar Coloring Books and Character Stickers.

Energenius Coloring Calendar

03-2529 11/90

BEST COPY AVAILABLE

Let's Get Energized: Energy Education for After-School Enrichment

Check first with: PG&E, Ed. Services
77 Beale Street, Room 2825
San Francisco, CA 94106-9900 -or-
CEES
1400 Tenth Street
Sacramento, CA 95814
(916) 323-4388

This is an assortment of energy activities taken from several sources by the El Dorado County Office of Ed. They are intended for use in after-school programs and not necessarily designed for classroom use. (200 pages; free; 1989.)

REPORT CARD
grades K-6

Teaching and Learning .....B

Presentation and Organization .....B

Energy Content .....B-

Disciplines:
Interdisciplinary

Teaching and Learning: Hands-on experience and various learning modes are utilized. Energy information is not covered in depth. The activities are grade-level appropriate. There are poor assessment devices.

Presentation and Organization: Ideas presented are adaptable for varied learning situations. The organization is easy to understand and use. There is no natural progression from activity to activity.

Energy Content: There are some good activities for getting students directly involved in energy conservation, but the relation between renewable and nonrenewable energy is weak.

Teachers' Thoughts: This collection of quality activities is drawn from many different sources. The Table of Contents is organized (small group, large group, quiet activities, labs, etc.) in a unique and appreciated format. The main weakness was that there is no building on concepts for a comprehensive understanding of energy.

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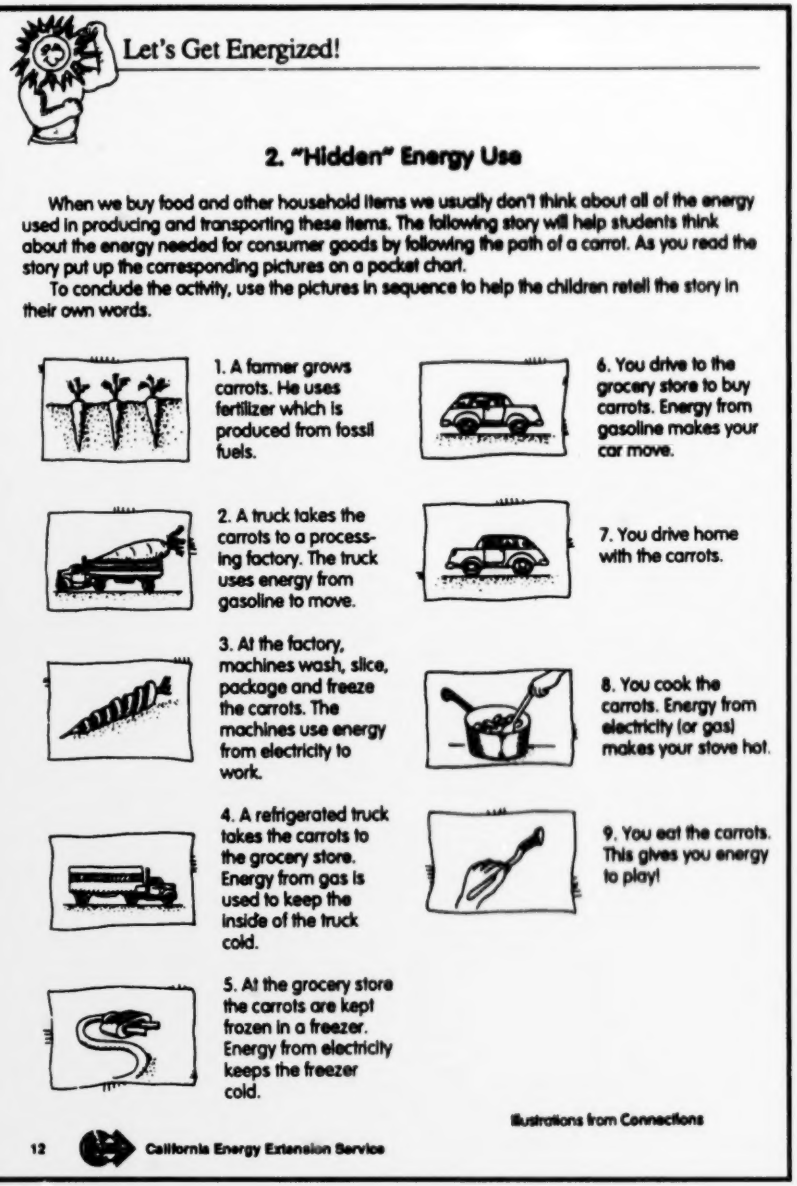


Let's Get Energized!

2. "Hidden" Energy Use

When we buy food and other household items we usually don't think about all of the energy used in producing and transporting these items. The following story will help students think about the energy needed for consumer goods by following the path of a carrot. As you read the story put up the corresponding pictures on a pocket chart.

To conclude the activity, use the pictures in sequence to help the children retell the story in their own words.

1. A farmer grows carrots. He uses fertilizer which is produced from fossil fuels.

2. A truck takes the carrots to a processing factory. The truck uses energy from gasoline to move.

3. At the factory, machines wash, slice, package and freeze the carrots. The machines use energy from electricity to work.

4. A refrigerated truck takes the carrots to the grocery store. Energy from gas is used to keep the inside of the truck cold.

5. At the grocery store the carrots are kept frozen in a freezer. Energy from electricity keeps the freezer cold.

6. You drive to the grocery store to buy carrots. Energy from gasoline makes your car move.

7. You drive home with the carrots.

8. You cook the carrots. Energy from electricity (or gas) makes your stove hot.

9. You eat the carrots. This gives you energy to play!

Illustrations from Connections

12 California Energy Extension Service

51

Hot Water and Warm Homes

Teacher's Guide
LHS Gems
Great Explorations in Math and Science
Lawrence Hall of Science
University of California
Berkeley, CA 94702
(415) 642-7771

This is a booklet full of activities that teach about using solar energy at home. The concept of controlled experimentation is emphasized in this unit. This is just one of the Lawrence Hall of Science's "GEMS" (Great Explorations in Math and Science), a series of activity books. (48 pages; $7.50, plus shipping; 1986.)

REPORT CARD
grades 4-6

Teaching and Learning .....B

Presentation and Organization .....B

Energy Content ..... C+

Disciplines:
Math
Science

Teaching and Learning: There are lots of hands-on activities included. The scientific method is used and the concepts are related to student's experience. The assessment devices are weak.
Presentation and Organization: "Hot Water and Warm Homes" is well-organized and includes high quality student materials. The format is easy to use.
Energy Content: These materials are so focused that they don't cover a lot of basic energy information. Solar heat is covered in-depth.
Teachers' Thoughts: Teachers reacted very positively to these classroom-friendly activities. Everyone thought they could be easily incorporated into the classroom and would "generate a lot of exciting learning."

Session 4: The Solar Water Heater Experiment

Overview

In this activity, students discuss conventional home water heaters and then conduct an experiment to heat water using aluminum pie pans and sunlight. The experimental variable is whether the pan is enclosed in a plastic bag (covered) or not (uncovered).

This activity is best done on a sunny day with little or no wind. But even on a cloudy day you will get interesting results!

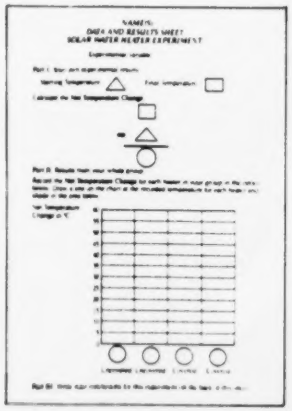
Time Frame: 45 minutes

What You Need

For each student:
- ☐ 1 paper cup (5 oz. size)
- ☐ 1 aluminum pie pan (8" size)
- ☐ 1 piece of cardboard 6" x 6" (16 cm x 16 cm)
- ☐ 1 data sheet "The Solar Water Heater Experiment" (master included, page 33)
- ☐ 1 thermometer (C)
- ☐ 1 pencil

Optional:
- ☐ 1 manila file folder or clipboard for outside recording

For a class of 32:
- ☐ 16 clear plastic bags (standard size for produce) with twist ties
- ☐ 1½–2 gallons of water (6–8 liters) in two buckets or basins
- ☐ The water should be ambient outdoor temperature or less (but not warmer!)



BEST COPY AVAILABLE

Offalot, Energy Choices and Challenges, Power Switch, Bright Land, Energy Crunch, Fossil Fuel Junction, and Energy in American History

Check with your local utility first -or-
Energy Source Education Council
Program Distribution Office
5505 East Carson, Suite 250
Lakewood, CA 90713
(213) 420-6814

Each title represents a different grade-level-teaching package which includes; teacher's guide, student booklets, filmstrips, audio tapes and posters. (Tapes and filmstrips were not evaluated.) Each is packaged in a cardboard container, a preview copy can be requested. Thesevary in quality but evaluated together here due to space limitations, grades are averages from all titles. Please look to the right for descriptions and grade level of individual titles. (Student booklets are 16-40 pages; free from some local utilities, 1988.)

REPORT CARD
grades K-12

Teaching and Learning .....B	Disciplines:
Presentation and Organization .....B	Language Arts Math Science Social Studies
Energy Content .....B-	

Teaching and Learning: All of the units performed well except Fossil Fuel Junction and Energy in American History. The learning environment was limited and hands-on activities were weak in these two units.
Presentation and Organization: Instructions are clear and the illustrations bright. Suggestions for further investigation and activity extensions were lacking.
Energy Content: All the energy basics are covered, just not in one unit. There is good depth of treatment and some student participation in energy conservation.
Teachers' Thoughts: These are very professional-looking materials that teach specific energy topics. For a complete unit on energy, these would be supplemental. *Offalot* and *Energy Choices and Challenges* were particularly popular, teachers feel they are well assembled lessons.

Each title is listed here in the order of how they ranked when evaluated. Included is reference to the appropriate grade level and disciples. Sample pages from Offalot and Energy Choices and Challenges are on the following page.

OFFALOT, Grades Kindergarten, Interdisciplinary.
Offalot is a furry puppet who introduces children to energy use and safety. The unit consists of ten lesson, each about twenty minutes in length. Included are a puppet, teacher guide, student booklets, cassette tape, picture cards, story cards, poster, home activity booklets and badges.

ENERGY CHOICES AND CHALLENGES,
Grades 9-12, Science and Social Science
Social, technological political economic and environmental issues are explored in this unit requiring twelve class periods. It uses discussion questions and activities to study current energy topics.

POWER SWITCH, Grades 5-6, Interdisciplinary.
The three major fuel eras are discussed and future energy sources are discussed. Lifestyles and energy use around the world are looked at in one chapter.

BRIGHTLAND, Grades 1-2, Interdisciplinary.
Basic energy concepts such as heat, light and motion, how energy gets to our homes, and conservation are intrduced in this unit. Ten lessons each requiring about thirty minutes make up the unit.

ENERGY CRUNCH, Grades 7-9, Science.
This two to three week unit explores energy basics, supply and demand, conservation and energy sources from variouse positions. Students study research facts and make decisions on the pros and cons of energy issues.

FOSSIL FUEL JUNCTION, Grades 3-4, Interdisciplinary.
In this ten lesson unit students learn about how fossil fuels are aquired and used. Using activities tudents are encouraged to develop and follow personal conservation plans.

ENERGY IN AMERICAN HISTORY, Grades 7-9, Social studies.
This unit helps students understand how energy has shaped American history. It consists of 15 lessons and requires about two weeks to complete. The content correlates well with lessons on the Industrial Revolution and 20th Century.

Offalot Settles an Argument

Eric and Sandra were having an argument. Offalot heard them arguing. "What's the problem?" asked Offalot.

"Eric says that using energy costs money, and I say it doesn't," Sandra said.

"That's an easy argument to settle," Offalot said. "You're both right. Sometimes it costs money to use energy, and sometimes it doesn't." Eric and Sandra looked confused. "Come on," Offalot said. "Let's take a walk. I'll show you what I mean."

They went to the park. "Look around," Offalot said. "There are many people here using energy that doesn't cost money—like those people riding bikes and those people playing baseball. The energy doesn't cost anything because they're using their own energy to pedal the bikes and to hit the ball and run. We don't have to pay to use our own energy."

"What about that person flying a kite, and those people sailing boats on the lake?" Eric asked. "Are they using energy that costs money?"

"They're using energy from the wind to make their sailboats move and their kites fly," Offalot answered. "It doesn't cost any money to use energy from the wind."

"What about the sun?" Sandra asked. "We get energy from the sun, don't we?"

"Yes," said Offalot. "We can stand in the sun and get warm without paying for it."

"I think I'm beginning to understand," Sandra said as they walked home. She pointed to the cars and trucks moving down the street. "Cars and trucks use energy that costs money. We have to pay for the gasoline that makes them run."

"That's right," Offalot said.

They were back at Eric's and Sandra's house. They went inside. "At home, we use lots of energy that costs money," said Offalot.

"What kinds of energy?" Eric asked.

"Well, we pay for the natural gas that heats the house and runs the water heater, range (stove), and clothes dryer. And we pay for the electricity that runs many energy users in our homes," Offalot explained.

"Like the refrigerator and the washing machine?" Eric asked.

"And the television and the toaster?" Sandra added.

"Right," Offalot said. "You've learned a lot about energy today."

"Thank you," said Sandra and Eric.

Offalot smiled. "I'm always glad to help when it comes to energy. Goodbye for now." As Offalot walked away, Eric and Sandra began to argue again. This time they were arguing about what television show to watch.

What are some ways we use energy that costs money?
(We drive cars, we heat our homes with heaters; we wash our clothes in washing machines; we keep our food cold in refrigerators; we cook our food on stoves; we watch television, etc.)

What are some ways we use energy that doesn't cost money?*
(We ride bicycles; we skate; we fly kites; we read books; we play the piano; we open the drapes to let in the sun's light and warmth, etc.)

*Some pupils may mention that we pay for food, which supplies our bodies energy. Point out that even though we pay for the food we eat, our bodies turn the food into energy for free. We must pay energy companies to make oil into gasoline, or to make electricity. Also point out that all items cost money to buy, but some also cost money to use, while others do not.

The Power Switch Energy Education Unit
Teacher Guide

The Power Switch Energy Education Unit introduces fifth and sixth grade students to the history of energy and to our present and potential future energy sources. The unit consists of a complete set of teacher and student materials, including everything needed to conduct instruction. The materials and activities focus on four specific learning objectives.

1. Understanding Energy Concepts

Pupils learn the following concepts:

- The three major fuel eras in the United States have been the wood, coal, and oil eras.
- During each fuel era, energy has been used with little concern about conservation.
- Our use of energy has increased throughout our history.
- Electricity is produced in power plants by either steam or water.
- Some energy sources are renewable and can be used over and over again. Others, like the fossil fuels, are nonrenewable.
- Our reserves of fossil fuels, especially oil and natural gas, are dwindling.
- There is an imbalance of energy in the world. The United States produces and uses more energy than any other country.
- The amount of usable energy available in a country strongly influences the lifestyles of its people.
- We should conserve energy and there are many ways we can.
- We are entering a period that will be characterized by a greater variety of energy sources.

2. Identifying Fuel Eras

Pupils identify the time period (pre-1885, 1885-1950, post-1950) in which given events involving the use of energy would most likely have occurred.

3. Identifying Energy Sources

Pupils identify a particular energy source given a description of how energy is produced from that source.

4. Identifying Advantages and Disadvantages of Present Energy Sources

Pupils identify a particular energy source given a description of an advantage or disadvantage of that source.

BEST COPY AVAILABLE

Energy Activities for the Primary Classroom

Check first with: PG&E, Educational Services
77 Beale Street, Room 2825
San Francisco, CA 94106-9900 -or-
California Energy Extension Service
1400 Tenth Street
Sacramento, CA 95814
(916) 323-4388

This energy education program provides primary-level students with an understanding of energy, its various forms, its importance, energy conservation, and related careers. The collection comes with a list of concepts and indicates which activities best illustrate those concepts. (60 pages; free; 1985)

REPORT CARD
grades K-3

Teaching and Learning .....B

Presentation and Organization .....B-

Energy Content ..... B-

Disciplines:
Art
Language Arts
Science
Social Science

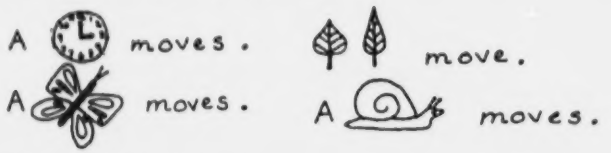
Teaching and Learning: There are no assessment devices, but varied learning modes are well addressed. The activities are suited to the primary classroom. A wide variety of topics are introduced. Integrated disciplines are used.
Presentation and Organization: Activities are readily integrated into an established curriculum. Further investigations or activity extensions are not provided.
Energy Content: The activities have students actively involved with energy conservation, but lack discussion of values or personal roles.
Teachers' Thoughts: Language arts are well integrated into these materials. Teachers felt this was a very functional source for a lot of great activities. Some feel it was a bit hard to read, while others really like the appearance.

1. WHAT IS ENERGY?

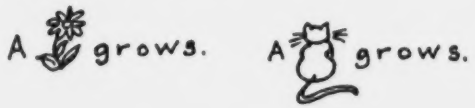
In the 1989/1990 version of the Science Curriculum for California, energy is one of six themes or "big ideas" that links the physical, earth and life sciences.

Energy is . . .

1. In physics, energy makes things go. Energy causes movement. Every time you see something move, energy is being used. A leaf moving in the wind, a pot of water bubbling on the stove, and a car traveling to the store are all evidence of energy being used.
You know that energy exists because you can see or feel what it does. Energy moves cars, makes machines run, heats ovens, and lights our classroom.



2. In biology, energy makes things grow.



Finding Energy

You know energy exists when you notice motion, heat, or light. Energy heats our classroom. Energy lights our classroom. Energy moves the bus that brings you to school.

Have students look for: **motion, heat,** and **light**

Make a list and/or book for each. Evidence of energy is everywhere!

The N.E.E.D. Project

P.O. Box 2518
Reston, VA 22091
(703) 860-5029

NEED's teaching materials are usually provided with an introductory workshop. The materials evaluated included: "Energy Exchange," a tri-annual publication that includes curriculum, background information and activities; "NEED Resources," with energy facts and free resources; "NEED Activities," a collection of games, plays, and other educational activities; "That's Energy Education," a drama with energy facts; and "Youth Awards Program," explaining the NEED contest rules/ awards and includes an energy carnival kit. (185 pages; Free membership; 1988.)

REPORT CARD

grades 3-12

Teaching and Learning .....B

Presentation and Organization .....B-

Energy Content .....B-

Disciplines:
- Art
- Interdisciplinary
- Language Arts
- Math
- Science
- Social Science
- Science, Tech. & Society

Teaching and Learning: The activities provide for all learning modes and rate average on assessment devices and use of the scientific process. While societal issues are mentioned, personal ethics are not emphasized. Assessment devices are average.

Presentation and Organization: Organization of these materials is weak. There are some good illustrations, but the presentation is dull in places. The activities are adaptable to varied learning situations.

Energy Content: The different energy sources are covered very well; energy flow is not covered in depth.

Teachers' Thoughts: In general, teachers liked this creative collection of varied energy activities. Without an introductory workshop, the materials "are a jumble." Student appeal is a strong point: "Kids like this type of material and seem to learn from it."

The Energy Group

(Teacher's Guide)

GOAL: To produce a lively talk show on four current energy issues

Before You Begin

Teacher's Instructions to NEED Activities: Make sure you have read the teacher's instruction sheet that's provided in the front of the NEED Activities guide before you begin this activity. This sheet gives you general instructions and suggestions for conducting all NEED activities. It's an invaluable resource.

The Group Contract: For all NEED cooperative learning activities, you must have your students read and sign the Group Contract sheet that's provided in the front of the NEED Activities guide. The Group Contract tells students what's expected of them and has them agree to work together as a team for a project.

Background

The Energy Group is a spin-off of *The McLaughlin Group*, a weekly public affairs television program shown on many NBC and PBS stations. This cooperative learning activity is geared toward upper-level junior and senior high school students. It requires students to explore and dissect several of today's and tomorrow's most interesting and controversial energy headlines. After they research their energy issues, student groups will write a script for a 30- to 40-minute "television" show. Student groups will present their shows in your class or, alternatively, in a school-wide program.

How to Organize

STEP 1 Before your students get started on their projects, you will need to make a few decisions. First, decide if you want students to present their shows in your class, or if you want them to present their shows in a school-wide program. If you decide to have the shows presented before the whole school, secure a date and location for the show now.

STEP 2 Next decide what energy issues you want your students to explore. Some possible topics are the Clean Air Act, nuclear disposal sites, recycling laws, mandatory mileage requirements, and acid rain legislation. You might also have your students present the sample ethanol issue as one of their four issues. This is an especially good idea if you want to trim the time students spend on this activity.

Assign your students to groups at this point too. This activity has been specifically designed for five students per group – one moderator and four commentators.

As an alternative program, you might consider asking energy experts from business, industry, government, environmental groups, or universities to serve as guest commentators on an energy show. In this case, you would need one quick-thinking and capable student to serve as the moderator for the show. If you do decide to use real energy experts, you should definitely consider presenting the show to a school-wide audience. Just make sure the experts have a wide range of views so that all sides of the issues are presented. This also makes for a livelier show!

STEP 3 Now that you have decided on the energy issues and assigned students to groups, gather together any preliminary resource materials for your students to help them get started. Also, if you already know of some great articles and films or of some energy experts that students could contact, make a list of the resources and encourage your students to use them.

STEP 4 Next make copies of the Group Contract sheet, the student activity sheet, and the sample Energy Group show. With the exception of the Group Contract sheet, NEED recommends one copy for each student.

STEP 5 Now you're ready to introduce your students to this activity. If possible, show them part of a tape of *The McLaughlin Group* to give them a taste of what they're trying to achieve. Check your local television listings for the show's time in your area; it's usually aired on a Saturday or Sunday.

STEP 6 Once your students are underway with their projects, your main tasks will be guiding them along and grading their assignments. You can expect this activity to take between five and seven class periods. You can lessen the time students spend on it in class by making some of the assignments homework. For instance, reading the sample show or designing posters make ideal homework assignments.

As for grading, you can select your own grading scheme, or you can use the scheme outlined below.

Sample grading scale:

Assignment 1 (List pros/cons)	10 points
Assignment 2 (List sources)	10 points
Assignment 3 (List pros/cons on issues)	20 points
Assignment 4 (Mini-scripts)	20 points
Assignment 5 (Visual displays)	10 points
Assignment 6 (Final script)	30 points
Energy Group show	100 points
TOTAL POINTS	200

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California Challenge!

Energy Center
Sonoma State University
Rohnert Park, CA 94928
(707) 664-2577

This is a board game that can be readily modified to work in just about any classroom. Students get very practical experience with listening, reading and learning. The questions are instructive and are related to all the disciplines. (Game board, cards and 60-page guide; price depends on version ordered $16-$20; 1989.)

REPORT CARD
grades 4-6

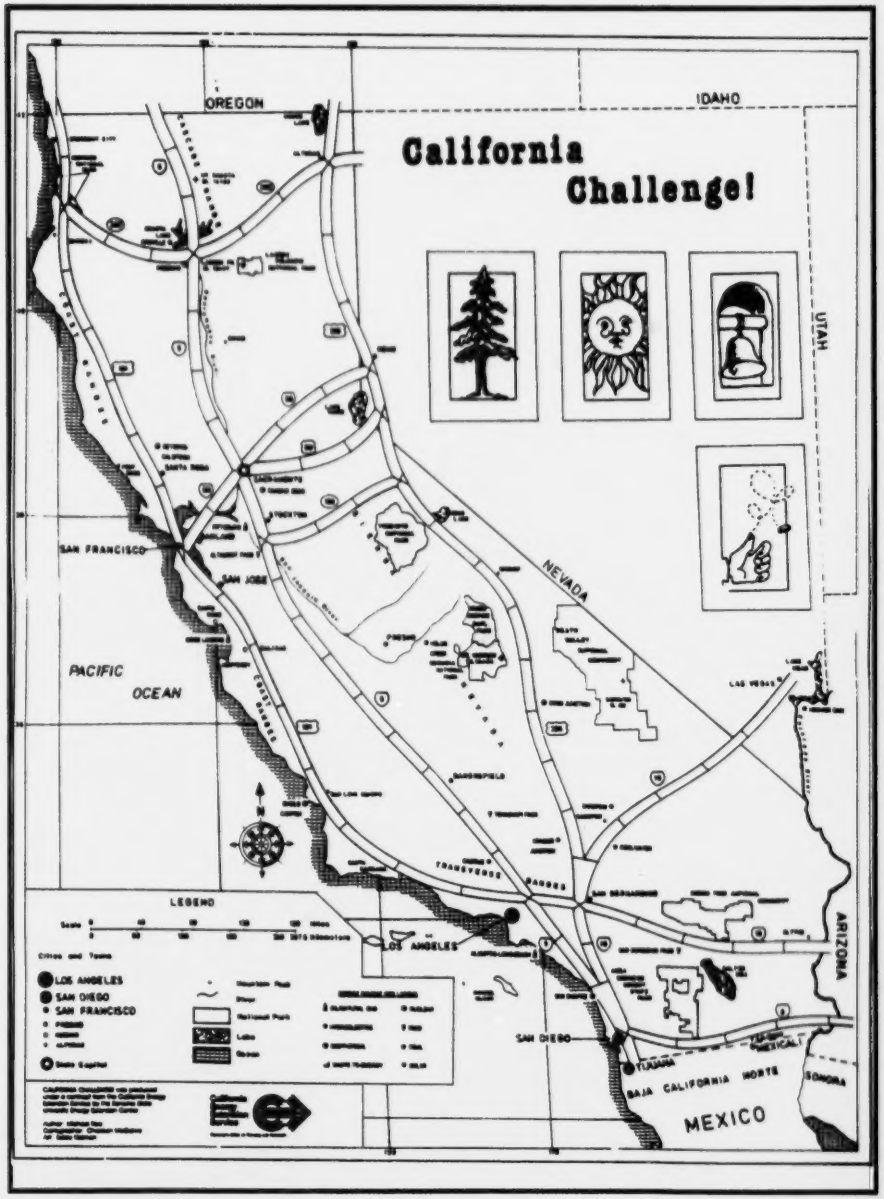
Teaching and Learning .....B-

Presentation and Organization .....B

Energy Content .....B-

Disciplines:
Language Arts
Math
Science
Social Studies

Teaching and Learning: There is a lot of content taught with this game. The game is readily adapted to varied classroom situations and different locations within California. The learning modes and environment are limited.
Presentation and Organization: "California Challenge" is simple to use and adaptable to individual classrooms. It can be reproduced for schoolwide use.
Energy Content: The only limitation noted is a lack of student involvement in actual energy conservation. A lot of history, math, and geography are included and related to energy information.
Teachers' Thoughts: There is a wonderful integration of science, social studies, geography and math. Designed for the 4th grade, some felt it would be a functional review through junior high. The map/board requires time to be made ready for play.



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Energy Skill Builders

Check your local utility first -or-
Enterprise for Education, Inc.
1320-A Third Street, #202
Santa Monica, CA 90401
(213) 394-9864

There are 17 different Skill Builders. Each is a lesson set which includes student booklets, a Teacher's Guide, and a reproducible quiz. Each title is listed here with grade level (they are ordered individually): The Atom and Radiation, grades 6-12, Climate and Comfort, grades 6-12, Coal: Once & Future King, grades 6-9, Demand for Electricity, grades 6-9, Efficiency of Electric Appliances, grades 6-10, Energy Transformations, grades 4-9, Geology of Oil, grades 6-12, Generating Electricity, grades 5-9, Greenhouse Effect and Global Warming, grades 6-12, Math Skill Builder, grades 6-8, Natural Gas, grades 6-12, Nuclear Fuel Cycle, grades 8-12, Nuclear Reactor, grades 8-12, Refining Oil, grades 8-12, Sources of Electricity, grades 5-9, Using Our Resources Wisely, grades 2-4, Working with Energy Graphs, grades 6-12 (8 or 16 pages; price varies with volume; 1987-91.)

REPORT CARD
grades 2-12

Teaching and Learning .....B

Presentation and Organization .....B

Energy Content .....C+

Disciplines:
Chemistry
Earth Science
Math
Physical Science
Science
Social Studies

Teaching and Learning: The activities are not unique but the information is organized thematically, grade-level appropriate and treated accurately. The inclusion of values was average.
Presentation and Organization: The organization and teacher instructions are good, but there are no extensions included.
Energy Content: Energy sources are explored, but the role of individuals and society in energy issues is weak.
Teachers' Thoughts: Each of these short attractive pamphlets has a narrow focus. While there are not a lot of hands-on activities, teachers felt the discussion materials would promote critical thinking.

What Is Natural Gas Used For?

Natural Gas Is a Raw Material

Natural gas is used as a raw material to produce other chemicals. Chemicals manufactured from oil and gas are called petrochemicals. The first petrochemical was made in 1872, from natural gas. Your teacher can show you how to make this petrochemical.

The very small black particles you made are carbon. This form of carbon is called carbon black. Carbon black is used in inks, paints, and black rubber tires.

One of the most important uses of methane is to make fertilizer, to give plants nitrogen. Natural gas does not contain nitrogen, but it can be used to take nitrogen from the air. The methane (CH_4) is used to make ammonia (NH_3). The ammonia can be used as a fertilizer itself, or it can be made into other fertilizers.

Many important solvents are made by adding chlorine atoms to methane, including methyl chloride (CH_2Cl_2, two of the hydrogen atoms are replaced with chlorine atoms) and carbon tetrachloride (CCl_4, all four hydrogen atoms are replaced with chlorine atoms).

Although the methane molecule is small, larger molecules can be made from it by stringing methane molecules together like beads on a chain. In this way, many other hydrocarbons can be made from methane. Plastics like polyethylene can be made from hydrocarbons made from methane.

Methane is also used to make methanol, a kind of alcohol, and acetylene, a gas used for welding.

Natural Gas Is a Fuel

Most of the natural gas that is consumed is burned as a fuel. Electric utilities burn it to generate electricity. It is used in almost every manufacturing process that needs heat, from baking bread to making glass. Natural gas provides more energy to homes in the United States than is provided by any other energy source.

WHERE DOES THE ENERGY IN HOMES COME FROM?

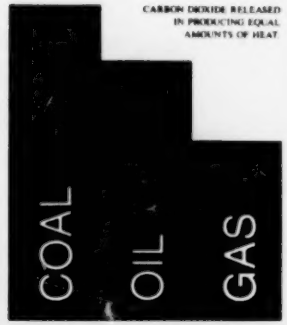
■ Fuel Oil & Kerosene ■ LPG
■ Natural Gas and Electricity ■ Other Electricity from Natural Gas

Comparing Natural Gas With Other Energy Sources

Natural gas is much more easily transported than coal or wood, and gas produces less pollutant when burned. Compared with the other fossil fuels, natural gas also gives off less carbon dioxide in relation to the amount of heat we get, because it has four hydrogen atoms for every carbon atom. No other hydrocarbon can equal that ratio. (People are interested in how much carbon dioxide is given off because carbon dioxide may cause global warming.)

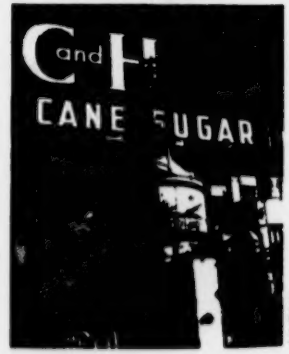
Electricity is also convenient, and can be used for many purposes for which gas cannot. If you need heat in your home, however, producing heat by burning gas is more efficient than producing heat with

CARBON DIOXIDE RELEASED IN PRODUCING EQUAL AMOUNTS OF HEAT



hot wires (as is done in most electric water heaters and baseboard heaters) using electricity made from natural gas. The efficiencies are much more comparable if the electricity is used to operate a heat pump.

THE CYLINDERS IN FRONT OF THIS BUILDING ARE GAS-FIRED BOILERS. THEY PROVIDE STEAM THE FACTORY USES IN REFINING SUGAR.



14

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4-H Home Conservation Guide

Check first with: PG&E, Educational Services
77 Beal Street, Room 2825
San Francisco, CA 94106-9900 -or-
California Energy Extension Service
1400 Tenth St., Rm 209
Sacramento, CA 05814
(916) 323-4388

This is a collection of 12 activities taken from other sources and compiled by the El Dorado County Office of Education. Its objectives are to provide 4-H members with reasons for conserving energy at home, to help teach weatherization concepts, and to provide instructions for hands-on projects. There are lots of illustrations to help guide the lessons. (32 pages; free; 1988.)

REPORT CARD
grades 4-12

Teaching and Learning .....B

Presentation and Organization .....B

Energy Content .....C+

Disciplines:
Language Arts
Math
Science

Teaching and Learning: There is a very strong connection between energy and day-to-day living. The activities are all hands-on. No assessment devices are provided. These teaching materials are useful in both urban and rural environments.

Presentation and Organization: There is no natural progression within the organization. Materials for students are amply provided and the objectives for the activities are clear.

Energy Content: The activities get students actively involved in energy conservation. The role of individuals, families and government in energy policy is explored. Various forms of energy and energy flow are not directly discussed.

Teachers' Thoughts: This is a "hodgepodge" of very "student do-able" activities. There is a non-academic approach and it does not discuss energy in depth. Teachers felt the materials were limited but loved the simple organization and the practical nature of the activities.

HOME ENERGY AUDIT

OBJECTIVE: By using this checklist, members and their families will become more aware of actions they can do to save money on home utility bills.

ENERGY CONNECTION: If 1,000 homes were to upgrade their insulation, caulk and weatherstripping - enough energy to operate 539 more weatherized homes would be saved.

AUDIENCE: This activity is an introductory activity for all members.

TIME: It will take approximately 30 minutes to explain the home energy audit at a meeting. Members will need a week to do the audit with their family. There would then be a 30 minute discussion after audits were done. This activity leads directly into the family energy plan.

PREPARATION: Make a copy of the Home Energy Audit for each 4-H member.

WHAT YOU WILL DO After the Energy Bucks game, kids are tuned into saving money and energy, through changes in energy use patterns and home conservation projects. You may wish to hand out this checklist after the members have played the Energy Bucks Board Game together. Be sure to let members know that the checklist is to help their families save money. Go over the checklist with members and answer questions they might have about language used in the checklist and how to summarize how much they are saving, and how much more they could save.

Savings are roughly estimated since members live in a wide variety of dwellings and climates. All members should be able to fill out the checklist as long as they have electricity in their homes. Members who do not have furnaces, central heating systems or heat pumps will not get savings from the heating and cooling section of the audit. They can still check the items which apply, but should not add up the savings.

Adopted from the Sacramento City/ County Energy Education Forum

Funds: CA Energy Extension Service , Production: El Dorado County Office of Education

Top Hit Energy Lesson Plans

National Energy Foundation
5160 Wiley Post Way, Suite 200
Salt Lake City, UT 84116
(801) 539-1406

There are six of these multidisciplinary activity guides for use in the classroom. There are separate guides for grade levels K-1, 2, 3, 4, 5, and 6. All are evaluated together here due to space limitations. (20-27 pages; $5 each; 1986.)

REPORT CARD
grades K-1, 2, 3, 4, 5, 6

Teaching and Learning .....B-

Presentation and Organization .....B

Energy Content .....C+

Disciplines:
Language Arts
Math
Science
Social Studies
Art
Music

Teaching and Learning: Lessons are related to students' lives and use different learning modes but the concepts are not always open to inquiry and assessment devices are weak.
Presentation and Organization: Instructions are clear and objectives easily discerned but the activities don't always follow a natural progression. Some activities are not grade level appropriate.
Energy Content: Discussion and comparison of renewable and nonrenewable energy is only fair. The activities do include student participation in energy conservation.
Teachers' Thoughts: Teachers liked having the activities broken down for specific grade levels and felt the format was very straight forward and easy to use. The content seemed a bit shallow or limited to some but most teachers feel these would be good supplemental materials.

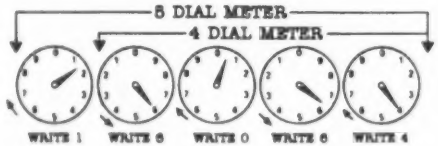
Activity No. 4
"Meter Reading"

HOW TO READ YOUR ELECTRIC AND GAS METER

Name: _____ Date: _____

How To Read Your Electric Meter

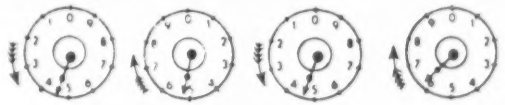
The dials are like watch faces lined in a row (every other dial moves counterclockwise). The reading for a five dial meter would be 16,064. The reading for a four diameter would be 6,064.



Notice that when the pointer is between two numbers, you should record the lower of the two numbers.

When the pointer seems to be directly on a number, look at the dial to the right, if the pointer on the right side dial has passed "0," then write down the number the pointer seems to be on; if the pointer on the right side dial has not passed "0," then write down the previous lower number on the dial you are recording.

How To Read Your Gas Meter



4
Take the number the first pointer has just passed...

4
And the number the third pointer has just passed...

6
And the number the second pointer has just passed...

6
And the number the second pointer has just passed...

Add two zeros 464600
This is the meter reading (in cubic feet of gas).

Copyright National Energy Foundation © 1986

Understanding Electricity

National Energy Foundation
5160 Wiley Post Way, Suite 200
Salt Lake City, Utah 84116
(801) 539-1406

This material includes a poster depicting a school and its electricity use, two booklets containing activities for teaching about electricity, and some student handouts. (30 pages + poster; $13; 1989.)

REPORT CARD
grades 1-6

Teaching and Learning .....B-

Presentation and Organization .....B

Energy Content C

Disciplines:
Language Arts
Math
Science
Social Studies

Teaching and Learning: Energy information is presented accurately, otherwise this material scored average. Values are not addressed in relation to energy use. The materials are good in both urban and rural settings.
Presentation and Organization: The organization is clear and easy to use. There is little help for further investigation of the topic area. Nice illustrations.
Energy Content: This material covers variouse energy sources well but does not discuss basics like energy flow or thermodynamics. Good explanation of personal and societal roles.
Teachers' Thoughts: Everyone really loved the poster that comes with the material and felt the activities could be a supplement to an elementary unit on energy. The failure to mention renewable energy, conservation, and energy ethics was the shortcoming of the material.

The Energist

National Energy Foundation
5160 Wiley Post Way, Suite 200
Salt Lake City, Utah 84116

These are newspaper format publications on Oil, Nuclear Energy, Coal, Electricity, Natural Gas, Water, and Renewable Energy Sources. Each one contains short articles, activities, and paper and pencil work. 8 pages each; $?; 1986 & 87.)

REPORT CARD
grades 9-12

Teaching and Learning .....B-

Presentation and Organization .....B

Energy Content ..... C+

Disciplines:
Science
Social Science

Teaching and Learning: These materials were not strong on scientific process and did not mention personal values. There are different learning modes used and average connection between students' experience and the information.
Presentation and Organization: Teachers felt these could be integrated into an established curriculum. Goals and objectives are not emphasized. Suggestions for further investigations were lacking.
Energy Content: Specific energy sources are directly addresssed. Energy flow and thermodynamics are not covered.
Teachers' Thoughts: Everyone loved the newspaper format and felt it would help reach non-text-oriented students. The content is dry at times and doesn't address environmental and social issues as much as several teachers would have liked.

Wind, Water, Fire and Earth

Energy Lessons for the Physical Sciences
NSTA
1742 Connecticut Ave. N.W.
Washington, D.C. 20009
(202) 328-5800

This is a collection of 19 classroom lessons complete with student handouts. They are designed for high school science classes. Included are activities that incorporate experiments, and some that have students do reading and research to answer questions. (124 pages, $9 plus, $2 +shipping, free from some utilities; 1981.)

REPORT CARD
grades 9-12

Teaching and Learning .....B-

Presentation and Organization .....B

Energy Content .....C+

Disciplines:
Chemistry
Earth Science
Geology
Physics
Science
Social Studies

Teaching and Learning: These materials include good hands-on activities, accurate treatment of content, and use the scientific method. A limited number of learning modes are used. There is good depth of treatment; values are not covered.
Presentation and Organization: The materials are easy to understand and the organization is good. Further investigations are lacking.
Energy Content: Thermodynamics and energy sources are covered. The connection of energy to society and technology is not particularly strong.
Teachers' Thoughts: The breadth of energy topics covered was appreciated. Most teachers felt these lessons would be functional in the classroom. The organization was clear and the quality of experiments high. The presentation was "dense," -- too much on a page. Most of the reviewing teachers felt this would be a good teacher resource for advanced students.

Manure Meadows and Milkshakes

The Trust for Hidden Villa
26870 Moody Rd.
Los Altos, CA 94022
(415) 949-8644

This is a general environmental education guide developed and used by the environmental education program at Hidden Villa's farm and wilderness area. It includes 15+ activities related to energy. (132 pages, $12.95+shipping; 1986.)

REPORT CARD
grades K-6

Teaching and Learning .....B

Presentation and Organization .....B-

Energy Content C

Disciplines:
Interdisciplinary

Teaching and Learning: There is a very strong connection between information and the student's life. Assessment devices are lacking here. Different learning styles are addressed and it includes lots of hands- on experiences. Especially good for primary grades.
Presentation and Organization: The materials are easy to understand and the organization is good. Student handouts are not provided.
Energy Content: Energy flow is covered but other topics are not specifically addressed.
Teachers' Thoughts: This is not designed to be energy education material specifically. There are many activities that relate to energy but this guide would not serve as your sole resource on energy. Reactions to this book were mixed. Many felt that this would be excellent material for a general environment unit and they liked the songs and drama included. This is full of great ideas but hard science information and evaluation was lacking.

Energy and Economics An Activities Book

Nebraska Energy Office
P. O. Box 95085
Lincoln, NE 68509
(402) 471-2867

This unit consists of eleven lesson plans incorporating economic concepts such as supply, demand, equilibrium, cartels, scarcity and the energy marketplace. Included are worksheets and simulation games with teacher background. (105 pages; free; 1988.)

REPORT CARD
grades 9-12

Teaching and Learning .....B-

Presentation and Organization .....C+

Energy Content ..... C+

Disciplines:
Science
Social Science

Teaching and Learning: The learning modes are limited. There is a strong connection between the student's life and the material. The knowledge is related to individual values and society, not good in rural setting.
Presentation and Organization: The teacher's instructions and goals are fairly clear. Illustrations are lacking and writing is dry.
Energy Content: Long-term benefits and costs are explored and student conservation is included. Weak on thermodynamics and energy flow.
Teachers' Thoughts: Great for an economics class only. The presentation was dry and not easy to use. Teachers felt that it would require a lot of their time to prepare for the lessons, and that students would need to be advanced. The content is good but not very accessible.

74

Know Nukes: Controversy in the Classroom

Antioch/New England Graduate School
Department of Environmental Studies
103 Roxbury Street
Keene, NH 03431
(603) 357-3122

The authors are concerned with producing an approach to science that integrates controversial issues. Included in each lesson is a lot of background information which is then covered in depth with either debates, written questions or other problem-solving exercises. (259 pages; $17.50, free from some utilities; 1985.)

REPORT CARD
grades 9-12

Teaching and Learning .....B-

Presentation and Organization .....B-

Energy Content C

Disciplines:
Science
Social Science

Teaching and Learning: The discussions relate energy to daily living. There are few hands-on activities. The materials are grade-level appropriate, include values, and can be used in both urban and rural environments.
Presentation and Organization: The teacher's instructions are clear and the goals are fairly clear. Suggestions for further investigations were lacking.
Energy Content: Personal energy use is well-addressed, and energy flow through an ecosystem is covered. The laws of thermodynamics are not clearly related to the rest of the material. There are no practical energy conservation lessons.
Teachers' Thoughts: If anyone wants to teach a unit on nuclear energy, this would be a great resource. Teachers felt the role-playing exercises would inspire the students. There is a lot of boring paper-and-pencil type of work included. Teachers were unsure how these materials would fit into an established curriculum.

75

II Appendix

- Environmental Education Curriculum and Compendium Overview
- Conceptual Matrices for Environmental and Energy Education
- Evaluation Tool
- Other Energy Curricula Evaluated
- Additional Energy Curricula Not Developed

Environmental Education Curriculum and Compendium Overview

Environmental education curriculum materials are, by their very nature, interdisciplinary. The wide spectrum of environmental topics and issues addressed in textbooks and supplementary materials alike are often interrelated. As more and more materials emerge to address environmental issues, teachers are in a quandary over which curriculum materials to choose. To make this review of materials manageable, existing curricula were sorted by logical, related topical areas, such as energy resources, water resources and air resources, to mention a few.

The first two topical areas presented themselves as logical prototypes for these documents. The California Energy Extension Service in the Governor's Office of Planning and Research and the California Department of Water Resources both published their respective compendia of curriculum materials in the 1980s. This project moves these existing documents three steps further, by (1) linking the two topics of energy and water to each other through the matrix of "unifying concepts of environmental education", developed by the California Department of Education; (2) establishing a "conceptual matrix" for each topical area based on those concepts; and (3) systematically reviewing, rating, and ranking selected environmental curricula. It is hoped that these documents will provide a cohesive foundation upon which subsequent documents for environmental education will be based. A review of air resources material is planned as the third in this series of compendia.

Unifying Concepts for Environmental Education

Both the "Conceptual Matrix for Energy Education" and the "Unifying Concepts of Environmental Education" which follow are based upon the processes of environmental education, as identified in the "Point of View on Environmental Education, " prepared by the California Department of Education in 1990. The content of environmental education is derived from the 1981 version of the *California Environmental Education Guide*, published by the Alameda County Office of Education. The content and processes of environmental education form the "X" and "Y" axes of the matrix.

The nine basic concepts of the conceptual matrix form a storyline which we hope students will be able to tell about energy resources. The story begins with an awareness and appreciation of how energy is used in the natural and built environments. The plot's substance and form are further developed by understanding how energy's physical and chemical properties enable life. The story culminates with student recognition of sustained responsible action through energy conservation, civic responsibilities, and personal choices. Students may tell their stories about energy resources through the visual and performing arts, mathematics, and language arts.

The basic concepts of energy resources correspond to the content of the *History-Social Science Framework for California Public Schools* (1988) and the *Science Framework for California Public Schools* (1990). Each concept may be further expanded by grade-level spans, which are kindergarten through third grade, third through sixth grade, sixth through ninth grade, and ninth through twelfth grade.

Woven throughout the basic concepts are several themes, or big ideas, for environmental education. The most prominent themes are: the development of **appreciation and deep respect** for the environment; the **systems and interactions** of living and nonliving things; and the importance of **conservation** as the cornerstone of sustainable communities.

Unifying Concepts Of Environmental Education

California Department of Education
Science and Environmental Education Unit

Content / Process	THE NATURAL ENVIRONMENT Natural Systems and Interactions	THE BUILT ENVIRONMENT Human Alterations to Natural Systems	THE PERSONAL ENVIRONMENT Citizens' Roles, Responsibilities, Choices, and Actions
Fostering Awareness of and Respect for the Environment	Environmentally aware citizens cultivate in themselves and others a deep appreciation for natural systems and personal interactions with the natural environment. *California Curriculum Framework References: Science: Living Things, Ecosystems, Oceanography*	The individual members of sustainable human communities value the natural environment and recognize humankind's ultimate dependence upon renewable and nonrenewable resources. *History and Social Science : Geographic Literacy; Science: Geology and Natural Resources, Living Things, Ecosystems*	An individual's quality of life and attitude toward the environment depend upon the distribution and quality of natural resources, which may be regulated by laws and influenced by local interests, cultural values, political climate, and international relations. *History and Social Science : Sociopolitical Literacy, Cultural Literacy, Constitutional Heritage, National Identity*
Understanding Basic Environmental Concepts	The ultimate source of energy is the sun, and its energy is transformed and lost as it flows through ecosystems, of which human beings are a part. *Science: Living Things, Energy, Ecosystems, Matter*	Human Communities alter the natural and built environments through development and, as human populations increase, their impacts on the global environment become more pronounced. *History and Social Science : Historical Literacy, Geographic Literacy; Science: Geology and Natural Resources, Science, Technology and Society*	Every human affects the environment and can influence change through individual and collective action, civic responsiveness, consumer preference, and career choice. *History and Social Science : Civic Values, Rights and Responsibilities, Sociopolitical Literacy, Participation Skills*
Sustaining Responsible Actions Toward the Environment	To sustain the integrity of natural systems, humans must minimize their effects on the environment by thoughtfully restoring and preserving habitats' and species' diversity and protecting the quality of all natural resources. *History-Social Science : Historical Literacy, Ethical Literacy: Science: Ecosystems, Geology and Natural Resources*	The individual members of sustainable human communities learn from past experiences, acknowledge human limitations, anticipate changes, and develop innovative systems to conserve resources vital to both the natural and built environments. *History and Social Science : Ethical Literacy, Critical Thinking Skills, Historical Literacy, Economic Literacy; Science: Geology and Natural Resources, Science, Technology and Society*	Citizens of sustainable human societies manage natural and built systems responsibly and, with current understanding, capability, and foresight, regulate the careful use of natural resources by analyzing the benefits, costs, tradeoffs, and long-term effects of each alternative. *History and Social Science : Civic Values, Rights and Responsibilities, Economic Literacy, Critical Thinking Skills, Participation Skills; Science: Science, Technology and Society*

Conceptual Matrix For Energy Education

Content / Process	THE NATURAL ENVIRONMENT Natural Systems and Interactions	THE BUILT ENVIRONMENT Human Alterations to Natural Systems	THE PERSONAL ENVIRONMENT Citizen's Roles, Responsibilities, Choices, and Actions
Fostering Awareness of and Respect for the Environment	All life requires energy which is the essential force causing change. *California Curriculum Framework References: Science: Ecosystems, Energy: Sources and Transformations*	Human communities develop and depend on energy from renewable and nonrenewable sources, altering the natural environment posetively and negatively in the process. *Science : Energy: Sources and Transformations, Energy: Heat, Energy: Electricity and Magnatism: History and Social Science:* Historical Literacy, Geographic Literacy, Economic Literacy	Quality of life depends on the distribution, quality, and quantity of water, a valuable regulated commodity. *History and Social Science : Cultural Literacy, Geographic Literacy, Sociopolitical Literacy*
Understanding Basic Environmental Concepts	The sun is the primary energy source for almost all ecosystems and cycles; energy is transformed and often converte to unused heat, but never lost. *Science: Energy: Sources and Transformations, Ecosystems*	Energy development, distribution, and use have long-term and short-term economic, environemntal, social, and political benefits and drawbacks. *History and Social Science : Economical Literacy, Sociopolitical Literacy: Science: Energy: Heat, Energy: Electricity and Magnatism, Ecosystems*	People through their expectations for a certain quality of life, lifestyle choices, and personal use of energy, create demands for certain types of energy.. *History and Social Science : Civic Values, Rights and Responsibilities, Sociopolitical Literacy, Participation Skills*
Sustaining Responsible Actions Toward the Environment	The complexity of simplicity of food webs affects the flow of energy through ecosystems; thus, the preservation and thoughtful managementof the natural environment as a whole is crucial for natural cycles to support life. *History and Social Science : Participation Skills, Critical Thinking Skills; Science: Ecosystems, Geology and Natural Resources*	Individual members of sustainable human communities use and conserve energy and develop renewable energy sources in anticipation of the needs of future generations. *History and Social Science : Geographical Literacy, Critical Thinking Skills, Economic Literacy; Science: Geology and Natural Resources, Science, Technology and Society*	People, through careers and civic responsibility, plan for the development, efficient use, regulation, conservation, and protection of energy resources based on an analysis of the benefits, costs, tradeoffs and long-term impacts on the natural and built environments. *History and Social Science : Civic Values, Rights and Responsibilities, Participation Skills, Critaical Thinking Skills; Science: Science, Technology and Society, Geology and Natural Resources*

The following evaluation tool used by the teachers to rate the materials was adapted from the *California Science Framework, Chapter 8, Instructional Materials Criteria.*

4.....3.....2.....1 excellent poor — 0 = not applicable

TEACHING AND LEARNING

PEDAGOGY

1. Do the materials encourage hands-on experience?
2. Do the materials offer the students the opportunity to practice scientific thought processes (e.g., hypothesis making, problem- solving, collecting and organizing data, analyzing, drawing conclusions)?
3. Is the content treated accurately?
4. Are concepts organized thematically?
5. Do the instructional materials offer opportunities for different learning modes?
6. Are concepts open to inquiry, presented non-dogmatically?
7. Are assessment devices appropriate?
8. Are the concepts being taught related directly to the students' problem-solving experiences?
9. Is the learning environment expanded, using the outdoors, field trips, outside speakers, etc.?

GENERAL CONTENT

10. Is the depth of treatment of the material adequate?
11. Is the material appropriate for the age level designated?
12. Are materials relevant to both rural and urban settings?
13. Are individual values included, as they pertain to the subject?
14. Are knowledge and learning shown as an enterprise connected to society?

PRESENTATION AND ORGANIZATION

15. Are the objectives clearly stated?
16. Are instructions for teachers clear?
17. Can the materials be adapted to varied learning environments (large or small class, mixed level classes, etc.)?
18. Is the writing engaging?
19. Can these materials be readily integrated into an already established curriculum?
20. Do the materials follow a natural progression?
21. Are the materials organized in an easy-to-use fashion?
22. Are student materials sufficiently supplied?
23. Are there suggestions for further investigations?
24. Are there good visual illustrations?
25. Are the materials called for reasonably accessible?

ENERGY CONTENT

26. Are the laws of thermodynamics addressed?
27. Is the flow of energy through ecosystems included?
28. Are various energy sources (solar, wind, hydro, conservation, geothermal, nuclear, oil, coal, natural gas, O.T.E.C., biomass) treated?
29. Are renewable and nonrenewable energy sources compared and contrasted?
30. Do lessons include actual student participation in energy conservation?
31. Do the materials help students understand the roles of individuals, families, communities, and government, in forming energy policy?
32. Is consideration given to long-term benefits and costs?
33. Relative to other energy curriculum you've seen how would you rate this?
    a) top 5 b) top 10 c) top 20 d) not in the top 20

Narrative responses, please:

34. What stands out about these materials?

35. What are the greatest strengths?

36. What are the greatest weaknesses?

Other Energy Curricula Evaluation

The following materials were evaluated by the teacher teams, but not chosen for inclusion due to their lower ratings on the four point scale. These items may be useful tools for teaching about energy, but did not meet the curriculum guide lines in some way.

Key to ratings: ✪✪✪✪ Excellent ✪ Poor

Rating Item

✪✪ *Electricity Choices*, grades 7-9, SMUD (Sacramento Municipal Utility District, Southern California Edison, or Los Angeles Department of Water and Power).

✪✪ *Energy in Science Series*, grades 9-12, National Energy Foundation, 5160 Wiley Post Way, Suite 200, Salt Lake City, UT 84116, (801) 539-1406.

✪✪ *Energy and Economics*, grades 9-12, National Energy Foundation, 5160 Wiley Post Way, Suite 200, Salt Lake City, UT 84116, (801) 539-1406.

✪✪ *Hawaii Energy Curriculum Guide*, grades K-12, Hawaii State Energy Office, DBED, Energy Division, 335 Merchant Street, Room 110, Honolulu, HI 96813, (808) 548-2334.

✪✪ *Classroom Energy Poster Puzzle*, grades K-4, Pacific Gas and Electric, Educational Services, 77 Beale Street Street, Room 2825, San Francisco, CA 9406-9900 or Alberta Energy, Energy Conservation Branch, Highfield Place, 2nd Floor, 10010 106 Street, Edmonton, Alberta, Canada, T5J3L8, (403) 427-5200, or California Energy Extension Service, 1400 Tenth Street, Room 209, Sacramento, CA 94814, (916) 323-4388.

✪✪ *Home Energy Poster Puzzle*, grades K-4, Pacific Gas and Electric, Educational Services, 77 Beale Street Street, Room 2825, San Francisco, CA 9406-9900 or Alberta Energy, Energy Conservation Branch, Highfield Place, 2nd Floor, 10010 106 Street, Edmonton, Alberta, Canada, T5J3L8, (403) 427-5200.

✪✪ *Energy Conservation Education for New York State*, grades 7-12, New York State Education Department, Room 232-M, Albany, NY 1223- (518) 474-3852.

✪✪ *The Magic of Electricity*, grades 3-6, LHS GEMS Lawrence Hall of Science, University of California, Berkeley, CA 94720, (510) 642-1016.

✪ *Energy Tech'Knowledgy*, grades K-6 (one publication for each grade), California Energy Extension Service, 1400 Tenth Street, Room 209, Sacramento, CA 95814, (916) 323-4388.

✪ *Energy and Man's Environment*, grades 9-12, 4980 W. Amelia Earhart Drive, Salt Lake City, UT 84116, (801) 539-1406.

✪ *The Energy Challenge*, grades 5-8, Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830.

✪ *Energy Reporter*, grades 9-12, Electric Power Research Institute, P.O. Box 10412, Palo Alto, CA 94303, (415) 855-2000.

✪ *Science Activities in Energy*, grades 4-9, Pacific Gas and Electric, or Arizona Energy Office, 3800 N Central, Suite 1200, Phoenix, AZ 85012.

Additional Energy Curricula Not Evaluated

Four newer items were not reviewed due to the timing of the review, and are worth mentioning. The first two items in particular won awards at the 1991 All States Energy Program Managers Meeting, sponsored by the U.S. Department of Energy, and may be of interest. Other items are listed in no particular order.

1. *Trash for the Long Haul*, grades K-12, January 1991, 153 pages, $17.00.
Missouri Energy Resources Project, 7838 Big Bend Road, Webster Groves, MO 63119.
Two-thirds of this book is dedicated to nine case studies that focus mostly on recycling issues. Very nicely presented.

2. *Elementary Energy and Environment Science Activities*, grades K-2, 3-4, and 5-6, June 1991 (originally published in 1984 by New York Energy Education Project), five guides— approximately 100 pages each, Free.
Pennsylvania Energy Office, 116 Pine Street, Harrisburg, PA 17101.
Purpose is to stimulate interest in environmental education and integrate the topic more effectively into general science curricula. Well organized with each activity beginning with a question. Fairly equal coverage of energy basics and personal choice.

3. *Impact! Environmental Activities with an International Focus*, grades K-6, 1990, $19.95 with bulk discounts available.
Environmental Literacy Group, 33770 Woodland Drive, Evergreen, CO 80439, (303) 674-3853.
A valuable collection of 6 units, well presented and organized with good information and questions that promote critical thinking. Among the six units is a unit on renewable and non-renewable energy, and another on oil spills.

4. *Think Earth*, grades K-3 and 4-6, Price not available.
Educational Development Specialists, 5505 E. Carson Street, Suite 250, Lakewood, CA 90713, (310) 420-6814.
Materials were developed by the same firm that brought us the *Energy Source* materials. These were developed for a consortium of business, government, education, and environmental groups to integrate air, water, land, and energy. Field tested in Los Angeles area.

5. *Science Projects in Renewable Energy and Energy Efficiency*, grades K-12, 1991, 140 pages, $10.00 plus $3.00 shipping.
National Energy Foundation, 5160 Wiley Post Way, Suite 200, Salt Lake City, UT 84116, (801) 539-1406.
Developed by the former Solar Energy Research Institute, the guide introduces the technologies and follows with ideas for experimental projects demonstrating the scientific method. Ideal for science fair projects. Topics include solar, photovoltaics, geothermal, superconductivity, wind, biofuels, hydrogen, and energy efficiency. One third of the book lists of resources.

6. *Breakthroughs*, grade level specific for grades 1-8, 1992, 25 pages, $19.95 teacher's edition, $4.95 for student booklets. Bulk discounts.
Zaner-Bloser 2200 West Fifth Avenue, PO Box 16764, Columbus OH 43216-6764, (800) 421-3018.
Each in the series of 58 interdisciplinary booklets focuses on a real-world issues such as rain forests, diminishing energy supplies, acid rain, and global warming. Series is being considered for adoption as science textbook in California. Fifteen units address energy issues including motion, windmills, rainforests, electricity, smog, and greenhouse. Emphasis on thematic teaching, critical thinking, and collaborative learning designed to implement recommendations of Project 2061. Good graphic organizers such as network trees.